IV.6 GROUNDWATER, WATER SUPPLY, AND WATER QUALITY

IV.6.1 Approach to Impact Analysis

This programmatic analysis considers groundwater basins within the Desert Renewable Energy Conservation Plan (DRECP) and Land Use Plan Amendment (LUPA) Decision Area for potential risk and environmental impact severity from proposed renewable energy project development in Development Focus Areas (DFAs). Groundwater basin boundaries and hydrogeological conditions vary within DFA locations. Most environmental impacts on groundwater resources depend less upon developed land area than upon technology, technology type, and water requirements.

Required water use for renewable energy projects is primarily determined by technology (e.g., solar, wind, or geothermal) and technology type (e.g., photovoltaic, concentrated solar thermal). For example, solar thermal plant operations require considerable water for steam generation, cooling, and other industrial processes, while wind projects require relatively little water for operation, maintenance, cleaning, and dust suppression. This programmatic analysis therefore considers estimated water use as the primary indicator of potential environmental impacts to groundwater, water supply, and water quality and recognizes that any increased water use, regardless of technology type, may adversely affect the resource.

Groundwater impacts generally happen at the scale of a groundwater basin rather than at the broader scale of a DRECP ecoregion subarea or DFA. Some impacts occur at even smaller scales (e.g., springs, streams, wetlands, groundwater-dependent vegetation, and water-supply wells within a basin or sub-basin). Quantifying these impacts requires both site-specific and project-specific details, including:

- Net changes in basin water balance, particularly in basins already in overdraft.
- Basin adjudication status and imported water availability.
- Degree of land subsidence.
- Groundwater connections to other basins or the Lower Colorado River Accounting Surface (LCRAS) region.
- Presence of a spring, stream, wetland, or playa that receives and discharges groundwater.
- Presence of groundwater-dependent vegetation.
- Groundwater quality.

- Existing water supply wells, groundwater users, and contributing sources of water discharged from a basin.
- Hydrogeology of water supply aquifers and any interaction with geothermal resources.
- Presence of sole-source aquifers.

Since many of these details are insufficiently quantified, this programmatic analysis uses estimated water use to both identify potential impacts and compare the alternatives; acreage, specifically as it relates to land disturbance, is an additional factor.

In the Proposed LUPA, DFAs represent the magnitude and geographic distribution of renewable energy projects in different alternatives. DFAs are also used to identify and map the locations (groundwater basins within the DRECP area) of impacts, their intensity (as indicated by proposed projects' water consumption in DFAs), and the scale of impacts (as measured by the total acreage disturbed by proposed development). Tables in Appendix R2.6 visually support this analysis and show the acreage of both development and conservation within the DRECP area, arranged by ecoregion subarea.

General metrics used to assess impacts and compare their effects within alternatives include:

- The acres affected by construction and operation, which could alter surface runoff and potentially alter rainfall infiltration, groundwater recharge, and water supply.
- The type of technology (particularly solar and geothermal) and its estimated water requirements. These water requirements affect the volume of pumped groundwater, which can in turn cause drawdown of water levels. Excessive drawdown can cause overdraft conditions, land subsidence, and mobilization of existing poor quality groundwater.
- The geothermal development areas; geothermal projects could adversely impact drinking water supplies when geothermal fluids are either re-injected or stored.
- The renewable energy technology area, where hazardous materials used during construction and operation could spill or be disposed of in a manner that contaminates groundwater.

The location of overdraft and stressed aquifers affects these metrics because they identify areas where groundwater supplies are severely limited. Overdraft is when the amount of water discharged from a particular basin or sub-basin (by pumping, evaporation, outflow, or other means) exceeds the amount of water recharging it (by precipitation, inflow from connected basins, and other inputs). Overdraft is when groundwater levels decline over years and never fully recover, even in wet years. Overdraft can lead to higher extraction costs, land subsidence, water quality degradation, and adverse impacts to existing users. In this document, California's Department of Water Resources (DWR) identified the basins in overdraft. If discharge remains stable, a new basin equilibrium could be reached; some impacts, however, including to groundwater storage capacity, could be permanently diminished. Stressed aquifers share some characteristics with basins experiencing overdraft but are not formally identified as in overdraft. For purposes of this assessment, basins not formally identified as in overdraft but still characterized by declining water levels are identified as stressed basins. Furthermore, because the basins are all located in a desert environment, any identified water use is significant. The California Statewide Groundwater Elevation Monitoring Program (CASGEM) minimum reported groundwater use for basins is <0.03 acre-feet (ac-ft)/acre. Accordingly, basins with a CASGEM reported water use greater than or equal to 0.03 ac-ft/acre are also considered to be stressed. Overdraft basins are listed in Volume III, Table III.6-1. Overdraft and stressed basins are shown in Figure IV.6-2, and in Section IV.6.3.2.1.

In this programmatic analysis, the volume of water consumed (expressed in either acre-feet per year (ac-ft/yr) or gallons per year) is the key metric for assessing and comparing potential environmental impacts from renewable energy projects to water resources among the alternatives, regardless of the quantity of power generated by consumption of that water (ac-ft of water consumed per megawatt [MW] produced). Water use for solar, wind, and geothermal development varies among the action alternatives. The geographical distribution of water use was estimated using typical consumption rates for different energy technologies and the spatial distribution of their generation within the DRECP area, as described in Appendix O (Methods for Megawatt Distribution).

The amount of electricity generated per unit of water consumed is described in the paragraphs that follow, but these values may change with time as technology continues to improve water-use efficiencies in power facilities. Subsequent project-specific environmental reviews will also more precisely define actual water use by specific technology type using actual operational characteristics (e.g., daytime operations, 24-hour operations, and other factors).

Typical water consumption rates for solar technologies are shown in Volume II, Section II.3.3.1.1. For solar photovoltaic facilities, regular cleaning requires 0.05 ac-ft/yr per MW. Solar thermal consumes more water, and the amount of water required for steam generation, cooling, and other industrial processes can be substantial. Solar thermal systems can be wet cooled, hybrid, or dry cooled. Wet-cooled systems use up to 14.5 ac-ft/yr per MW. Hybrid systems use dry cooling for much of the year, but switch to wet cooling when air temperature rises above approximately 100° F; hybrid systems use 2.9 ac-ft/yr per MW. Dry cooling further reduces the amount of water used, but also reduces efficiency and output capacity, particularly in hot desert climates. Dry-cooling systems use 1.0 ac-ft/yr per MW.

The LUPA Decision Area is mostly desert with scarce water supplies. Future solar thermal systems will likely use a dry-cooled system, which minimizes water consumption and is the best available technology at this time. For purpose of this analysis, water usage for dry-cooled solar thermal systems is assumed to be 1.0 ac-ft/yr per MW. Water usage for regular cleaning and other industrial processes of solar thermal systems is assumed to use 0.5 ac-ft/yr per MW.

Geothermal power plant water use is variable and depends upon both technology and water quality. Values have been determined for dry-cooled flash and binary geothermal systems ranging from 10 gallons per megawatt hour (MWh) to 270 gallons per MWh. (Clark et al. 2011). Enhanced dry-cooled geothermal systems can consume between 290 and 720 gallons per MWh. The DRECP assumes that geothermal facilities require 5.0 acres per 50 MW of installed capacity (DRECP, Appendix F1, Table F1-1). Assuming a 70% operating capacity, those values translate into a range of 0.2 to 70 ac-ft/yr per MW. While this is the general range, specific plant designs not expected to be constructed in the desert (i.e., not re-injecting the cooling water) can push this value over 1,900 ac-ft/yr per MW (Clark et al. 2013).

Geothermal power plants in California with a generating capacity of 20 MW or greater report their water use to the California Energy Commission (CEC), which in turn reports it in the CEC's Quarterly Fuel and Energy Report. The average reported values show higher than expected water use by enhanced geothermal systems, as reported by Clark et al. 2011. Fifteen plants reporting to the CEC had an average water usage for 2010 through 2012 of 1,748 ac-ft/yr (CEC 2014). The average annual reported water use was estimated by dividing 1,748 ac-ft/yr by 56 MW (31 ac-ft/yr per MW). Similar to solar thermal plants, the water use per MW for dry-cooled geothermal plants in the desert might be about an order of magnitude less than for wet-cooled geothermal plants (3.1 ac-ft/yr per MW). For the purpose of this analysis, water usage for wet-cooled geothermal systems was assumed to be 31 ac-ft/yr per MW.

Tables in this chapter show the total acreage of renewable energy technologies within each ecoregion subarea. The tables also report the geographic distribution of estimated water use, calculated using the energy generation described in Appendix O (Methods for Megawatt Distribution), as well as the estimated water use rates just described. These acreages, together with estimated water use, are used to estimate the geographic distribution of potential impacts on groundwater, both within basins and within DRECP ecoregion subareas.

IV.6.2 Typical Impacts Common to All Action Alternatives

This section qualitatively describes the primary types of groundwater-related impacts, direct and indirect, that are common to the renewable energy project alternatives in the DRECP area.

Renewable energy projects that grade the land surface, remove vegetation, alter the conveyance and control of runoff and floods, or cover the land with impervious surfaces, alter the relationships between rainfall, runoff, infiltration, and transpiration; this potentially interferes with groundwater recharge. In general, impacts to recharge in this desert environment are not expected to be large and are dependent on things like soil characteristics, elevation, and slope. Reduction of recharge, however, can be a concern for solar projects, which occupy large areas that could increase runoff and decrease transpiration (the process of water movement through a plant and its evaporation). Geothermal facilities have a smaller facility footprint than solar, and wind facilities have an even smaller one.

Groundwater extraction and consumption by renewable energy projects can cause groundwater levels to decline (drawdown). A number of potentially significant impacts could result from the drawdown and depletion of groundwater in storage:

- Declining water levels increase the needed pumping lift in wells, and gradually cause pumping rates to decrease and eventually cease altogether.
- Declining water levels may lower groundwater gradients and reduce groundwater discharge to springs, streams, rivers, and down-gradient hydraulically connected groundwater basins.
- Lowering the groundwater table can lessen the areal extent and vigor of wetland, riparian, or other groundwater-dependent vegetation areas.
- Groundwater discharge to playas can decrease and cause wet or damp lakebeds to dry out, causing greater wind scour and dust.
- As groundwater levels and fluid pressures decline, certain types of sediments (e.g., saturated clay units) can dewater and compress. This compression of sediment beds reduces their volume and can lower land surface elevations (land subsidence). This can potentially (1) cause damage to existing structures, roads, and pipelines; (2) reverse flow in sanitary sewer systems and water delivery canals; and (3) alter the magnitude and extent of flooding. This sediment compression can also permanently reduce aquifer storage capacity.
- Some basins, especially closed basins, have localized areas of highly saline groundwater that contain terminal playas with no surface water discharge. Water-

level declines in these basins can reverse existing groundwater gradients and flow directions, causing poor-quality groundwater near the playa to flow into surrounding parts of the basin, increasing salinity in those areas.

Renewable energy projects produce or use fluids that could contaminate groundwater if introduced to soil or groundwater. Projects typically have spill prevention and response plan requirements to identify and address violations of water quality standards. The most common concerns are vehicle fuels, solvents for equipment maintenance, heat transfer fluids, brines produced by groundwater demineralization (for consumptive use), and brines produced or used as part of geothermal operations. For example, brine produced as a by-product of groundwater demineralization typically evaporates in on-site ponds and is removed as hazardous waste. Some geothermal projects store brine in on-site ponds.

IV.6.2.1 Impacts of Renewable Energy and Transmission Development

Because LUPA land designations protect ecological, historical, cultural, scenic, scientific, and recreational resources, use of or access to groundwater for renewable energy projects would likely be limited. Even though other land uses within these areas are allowed, they must still be compatible with the resources and values that the land designation is intended to protect.

IV.6.2.1.1 Impacts of Site Characterization

Ground disturbances during site characterization could potentially impact both the quantity and timing of groundwater recharge. These disturbances could be caused by grading, clearing vegetation for roads and equipment, and characterization operations. Test borings may be required for structure design, as well as to determine aquifer conditions for water-supply assessments. These impacts apply to all technologies, but are of particular concern for solar projects since they typically cover large contiguous areas.

IV.6.2.1.2 Impacts of Construction and Decommissioning

Ground disturbances during construction could potentially impact both the quantity and timing of groundwater recharge. These could be caused by grading, clearing vegetation for equipment and operations, and temporary or permanent changes that could increase the likelihood of flooding or adverse drainage effects. Projects that grade the land surface, remove vegetation, alter the conveyance and control of runoff and floods, or cover the land with impervious surfaces can alter the relationships between rainfall, runoff, infiltration, and transpiration. This is of particular concern for solar projects since they typically occupy large areas and tend to increase runoff and decrease transpiration.

Installation of water supply wells and the consumption of the water they produce as part of construction or decommissioning can affect groundwater levels and storage volumes. Water volumes used during the construction period, particularly for dust control, are typically greater than the annual amount of water required during operations. This is particularly true for photovoltaic and dry-cooled solar thermal projects, which have lower operations water demand than wet-cooled solar thermal projects.

Construction activities use fluids that could contaminate groundwater if introduced to either soil or groundwater; this would violate water quality standards and waste discharge regulations. The most common concerns are vehicle fuels and solvents for equipment maintenance.

Decommissioning activities can include efforts to abandon water supply and monitoring wells, remediate contaminated soils or groundwater, and remove structures like solar arrays, mirrors, and other equipment. Improperly abandoned wells can create a conduit between land surfaces and underlying aquifers, or, with depth, between one or more aquifers distributed vertically. This is particularly true of geothermal wells with casing that typically passes through one or more “fresh” water aquifers to deep-water zones that produce high temperature but poor groundwater quality and brines. Decommissioning itself may also consume groundwater or adversely impact the quantity and timing of groundwater recharge. Reclamation plans typically require decompaction of affected soils, which may improve surface recharge. Also typical are re-vegetation efforts that may increase evapotranspiration or return its rate to predevelopment levels.

IV.6.2.1.3 Impacts of Operations and Maintenance

Likely activities during power plant operations and maintenance include potential groundwater contamination, interference with recharge, depletion of groundwater levels and storage, and other water quality impacts. Improper handling or containment of hazardous materials could disperse contaminants to soil and impact groundwater quality. Evaporation ponds may be required as part of cooling structures, and these may leak and possibly discharge brines and other contaminants to shallow groundwater.

Groundwater consumption affects both groundwater levels and storage volumes. Solar thermal and geothermal plant operations may require substantial amounts of water for steam generation, cooling, and other industrial processes. Less water is required for cleaning facilities like solar arrays, mirrors, and other project equipment. In contrast, water demand for for wind technology would be limited to relatively small volumes for operation, maintenance, cleaning, and dust suppression.

IV.6.2.2 Impacts of the Ecological and Cultural Conservation and Recreation Designations

Impacts on groundwater resources are determined by existing conditions within the groundwater basins where the projects are located, activities on the ground surface, and other project-related activities that require groundwater. Conservation actions would have an overall positive effect on groundwater protection since renewable energy development will be restricted in conservation areas.

IV.6.3 Impact Analysis by Alternative

The following sections present impact analyses for the No Action Alternative, the Preferred Alternative, and Alternatives 1 through 4.

IV.6.3.1 No Action Alternative

IV.6.3.1.1 Impacts of Renewable Energy and Transmission Development

The No Action Alternative assumes that renewable energy and transmission development and mitigation for such projects in the DRECP area would occur on a project-by-project basis in a pattern consistent with past and ongoing renewable energy and transmission projects. The estimated renewable energy development pattern is intended to be consistent with current development patterns and technology mixes that emphasize the following:

- Solar development in six ecoregion subareas with most development in three: the Cadiz Valley and Chocolate Mountains, Kingston and Funeral Mountains, and the Providence and Bullion Mountains subareas
- Wind development in the Pinto Lucerne Valley and Eastern Slopes and West Mojave and Eastern Slopes ecoregion subareas
- Geothermal development in the Imperial Borrego Valley ecoregion subarea

Potential renewable energy development on BLM lands within the DRECP area ecoregion subareas under the No Action Alternative is shown in Table IV.6-1 (solar only, geothermal only, and total renewable energy development for all technologies, including wind and transmission). Most of the area being developed is within four ecoregion subareas: the Cadiz and Chocolate Mountains, Imperial Borrego Valley, Kingston and Funeral Mountains, and Providence and Bullion Mountains ecoregion subareas. Three ecoregion subareas, the Owens River Valley, Panamint Death Valley, and Piute Valley and Sacramento Mountains ecoregion subareas, have no new development under the No Action Alternative.

Table IV.6-1 shows the estimated total new water demand anticipated within each ecoregion subarea for the No Action Alternative. Total water use was calculated using projected MW distribution and water use factors as already described in Section IV.6.1, Approach to Impact Analysis, and in Table IV.6-1, which shows a range of water use from a minimum of 6,000 ac-ft/yr (dry-cooled solar thermal plants and wet-cooled geothermal plants) to 30,000 ac-ft/yr (wet-cooled solar thermal and geothermal plants). The most intense water use, assuming dry-cooled solar thermal development, is in the Imperial Borrego Valley ecoregion subarea at 3,000 ac-ft/yr, due to 400 acres of geothermal development; there is no geothermal development in the other ecoregion subareas. The most intense water use, assuming wet-cooled solar thermal development, is in the Cadiz Valley and Chocolate Mountains ecoregion subarea: 13,000 ac-ft/yr, due to 29,000 acres of solar development.

Table R2.6-1 (Appendix R2) reports the acreage of groundwater basins within existing protected areas: Legislatively and Legally Protected Areas (LLPAs), Military Expansion Mitigation Lands (MEMLs), and existing BLM Areas of Critical Environmental Concern (ACECs). Under the No Action Alternative, these protected areas (about 4.3 million acres) and existing BLM Conservation Designations (about 1.7 million acres) would presumably provide ongoing conservation measures; however, there would be no conservation designation established to guide where future BLM conservation designations could be established, or where reserves could be assembled to offset the environmental impacts of renewable energy and transmission development. Therefore, the conservation areas generated from renewable energy or transmission developments are based solely on mitigation requirements imposed on a project-by-project basis. Under the No Action Alternative, existing BLM land use plans within the DRECP area would continue on BLM lands. These plans allow for renewable energy development in Solar Energy Zones (SEZs) and Solar Programmatic Environmental Impact Statement (Solar PEIS) Variance Lands. These projects are approved with a project-specific LUPA, if required.

Under the No Action Alternative, renewable energy development would be on BLM-managed lands in basins hydraulically connected to adjacent areas outside the LUPA Decision Area, including the State of Nevada (Middle Amargosa Valley, Pahrump Valley, Mesquite Valley, and Ivanpah Valley basins), Arizona (Palo Verde Mesa Basin), and Mexico (the Imperial Valley and Coyote Wells basins). Groundwater level and water supply changes can therefore cross across these boundaries and impact areas outside the LUPA Decision Area and the Colorado River.

The estimated acres of groundwater basins on BLM land designations outside the DRECP area under the No Action Alternative are summarized in Table R2.6-2 (Appendix R2). Existing land designations such as Special Recreation Management Areas (SRMAs), eligible and federally designated Wild and Scenic Rivers, and ACECs would continue to protect values and resources. These conservation actions are designed to avoid and minimize direct impacts on biological communities, so are not expected to adversely influence pre-project groundwater, water supply, and water quality conditions.

Table IV.6-1
Renewable Energy Development Area and Estimated Water Use – No Action Alternative

Ecoregion Subarea	Renewable Energy Available Development Area (acres)			MW	Water Use (AFY)	
	Solar	*Geothermal*	*Total*		*Minimum*	*Maximum*
Cadiz Valley and Chocolate Mountains	29,000	0	43,000	4,000	1,000	13,000
Imperial Borrego Valley	5,000	400	17,000	800	3,000	5,000
Kingston and Funeral Mountains	13,000	0	13,000	2,000	600	6,000
Mojave and Silurian Valley	0	0	2,000	0	0	0
Owens River Valley	0	0	0	0	0	0
Panamint Death Valley	0	0	0	0	0	0
Pinto Lucerne Valley and Eastern Slopes	500	0	4,000	100	20	200
Piute Valley and Sacramento Mountains	0	0	0	0	0	0
Providence and Bullion Mountains	10,000	0	11,000	1,000	500	4,000
West Mojave and Eastern Slopes	4,000	0	8,000	2,000	200	2,000
Total	**62,000**	**400**	**98,000**	**10,000**	**6,000**	**30,000**

Total megawatts for all technologies combined using the energy generation described in Appendix O (Methods for Megawatt Distribution).
Estimated solar thermal water use included industrial processes (0.5 ac-ft/yr/MW) and cooling (minimum estimate of 1 ac-ft/yr/MW represented by dry-cooled technology, and maximum estimate of 14.5 ac-ft/yr/MW represented by wet-cooled technology); photovoltaic water use for cleaning (0.05 ac-ft/yr/MW), and geothermal water use for cooling (assumed wet-cooled technology at 31 ac-ft/yr/MW); water use for wind assumed negligible.
Total development area is the sum of solar, geothermal, wind, and transmission project areas. Note that transmission acres include transmission only within groundwater basins.
Note: The following general rounding rules were applied to calculated values: values greater than 1,000 were rounded to the nearest 1,000; values less than 1,000 and greater than 100 were rounded to the nearest 100; values of 100 or less were rounded to the nearest 10, and therefore totals may not sum due to rounding. In cases where subtotals are provided, the subtotals and the totals are individually rounded. The totals are not a sum of the rounded subtotals; therefore the subtotals may not sum to the total within the table.

Renewable energy projects can impact groundwater recharge rates, groundwater elevations, groundwater in storage, the geologic substrata through compaction and land subsidence, or cause water quality impacts from spills and brine disposal. The impacts defined are the types identified by the lead agencies for approved solar, wind, geothermal, and transmission projects.

Impact Assessment

Impact GW-1: Construction of Plan components could alter groundwater recharge.

Changes in groundwater recharge alter the quantity of groundwater available to the environment, existing users, and to proposed projects. Projects that grade the land surface, remove vegetation, alter the conveyance and control of runoff, or cover the land with impervious surfaces alter the relationships between rainfall, runoff, infiltration, and evapotranspiration. Total project acreage is an indicator of the magnitude of the land surface disturbance and potential to alter runoff, infiltration, and transpiration. As shown in Table IV.6-1, 65,000 acres of land will be disturbed under the No Action Alternative for renewable energy projects, and almost half that affected land area occurs in the Cadiz Valley and Chocolate Mountains ecoregion subarea.

Impact GW-2: Groundwater consumption lowers groundwater levels, depletes water supplies, and affects groundwater discharge.

If local groundwater is the source of water for the project, groundwater extractions will cause drawdown, at least on the local level. Total water consumption is an indicator of the potential significance of drawdown. As shown in Table IV.6-1, the greatest water use under the No Action Alternative (calculated using the projected megawatt distribution and water use factors described in Section IV.6.1, Approach to Impact Analysis) is within the Imperial Borrego Valley (3,000 ac-ft/yr) and Cadiz Valley and Chocolate Mountains subareas (13,000 ac-ft/yr), depending upon which solar thermal cooling method is assumed. The Kingston and Funeral Mountains and Providence and Bullion Mountains ecoregion subareas also have relatively high water use, primarily from solar technology. Declining groundwater levels can cause the following:

- The energy required to extract the groundwater increases and, gradually over time, the well production rates decrease.
- The extent and vigor of wetland, riparian, or other groundwater-dependent vegetation areas can be at risk when the water table declines beneath these areas and the discharge decreases.
- Groundwater discharge declines to dependent springs, streams, rivers, and playas when the water table declines.
- The surfaces of some playas receive water from groundwater discharge; as discharge declines the lakebed dries, increasing wind scour and dust.
- Some groundwater basins receive inflow from adjacent basins, and these basins can be located either within or outside the DRECP area. This flow can occur within saturated alluvium that hydraulically connects adjacent basins, groundwater leaking

across an adjoining fault between basins, or as deep groundwater flow within a regionally extensive formation beneath relatively shallow alluvial basins. If groundwater is extracted from storage in the up-gradient/tributary basin, this may limit outflow into the down-gradient basin and diminish the resource.

Impact GW-3: Groundwater consumption could cause land subsidence and permanently decrease storage capacity.

As shown in Table IV.6-1, new renewable energy water use under the No Action Alternative calculated the projected megawatt distribution and water use factors, as described in Section IV.6.1, Approach to Impact Analysis. These could range from 6,000 to 30,000 ac-ft/yr. Most of that water use is attributed to solar development in the Cadiz Valley and Chocolate Mountains ecoregion subarea, or solar and geothermal development in the Imperial Borrego Valley ecoregion subarea. When groundwater is extracted and water levels decline over time, the pressure of water in pores between mineral grains in the alluvial sediments decreases and can cause certain types of saturated geological materials (e.g., clays) to dewater and compress. Similarly, when geothermal wells extract fluids from geologic strata that are typically thousands of feet below the water supply wells, these deep fluid withdrawals lower the fluid pressure in deep sediment beds and can cause them to compress. This compression reduces the volume of the sediment beds and lowers land surface elevations, which can damage existing structures, roads, and pipelines; reverse flow in sanitary sewer systems and water delivery canals; and alter the magnitude and extent of flooding along creeks, lakes, and storm management structures. This compression of materials also permanently reduces storage capacity. Total water consumption and the magnitude of development are indicators of the potential significance of impacts from subsidence.

Impact GW-4: Groundwater consumption could cause existing poor-quality groundwater to migrate.

As shown in Table IV.6-1, estimated new renewable energy water use under the No Action Alternative could range from 6,000 to 30,000 ac-ft/yr. Most of the water use is attributed to solar development in the Cadiz Valley and Chocolate Mountains ecoregion subarea or solar and geothermal development in the Imperial Borrego Valley ecoregion subarea. Some basins have localized areas of highly saline groundwater, particularly basins with terminal playas and no surface water outflow. Groundwater extraction and water level drawdown, over time, can change the existing groundwater gradient, causing poor-quality groundwater near the playa to flow into surrounding parts of the basin, increasing salinity in the affected areas. Total groundwater consumption, certain geological settings, and the magnitude and proximity of development to the highly saline groundwater areas are all indicators of significant drawdown potential, gradient changes, and impacts on groundwater quality.

Impact GW-5: Injection of water for geothermal steam generation could contaminate potable water supplies.

As shown in Table IV.6-1, 400 acres of geothermal development occur in the No Action Alternative in the Imperial Borrego Valley ecoregion subarea. Saline water re-injected during geothermal energy project operations can leak into relatively shallow water supply aquifers if an injection well casing fails. The magnitude of geothermal development in a basin is an indicator of its potential impacts on groundwater quality.

Impact GW-6: Chemical spills or brine disposal could contaminate groundwater.

Renewable energy projects produce or use hazardous fluids. In some circumstances, those fluids would influence groundwater quality if they leaked into an aquifer. The most common fluids are vehicle fuels, solvents for equipment maintenance, heat transfer fluids, brines produced by demineralization, and brines produced from geothermal extraction wells. Typically, reject brine produced by demineralizing groundwater evaporates in on-site ponds and any residue is disposed of properly. Geothermal projects also commonly store excess brine, produced by wells or cooling towers, in ponds. If the ponds leak or overflow, groundwater quality could be impacted. Additionally, improper handling and containment of hazardous materials (with transmission facility electrical equipment located inside and outside the DRECP area) could disperse contaminants to soil or groundwater.

The total area of renewable energy and transmission development is an indicator of potential groundwater quality impacts from chemical spills or brine disposal. As shown in Table IV.6-1, 65,000 acres of land would be developed under the No Action Alternative for renewable energy projects, increasing the potential for contamination in basins

Impact Reduction Strategies

Design Features of the Solar PEIS

The Solar (PEIS) includes Design Features (Appendix W) that would reduce the environmental impacts of solar energy development, including measures to control runoff (defined in WR1-1), measures to quantify groundwater aquifers and sustainable yield (defined in WR1-2), measures to secure a reliable and legally available water supply (defined in WR1-3, and impact reduction measures (defined in WR2-1, WR3-1, and WR4-1 for construction, operation, and decommissioning, respectively). These measures would apply only in BLM SEZs and Solar PEIS variance lands.

Laws and Regulations

Existing laws and regulations would reduce the impacts of renewable energy development projects in the absence of the Proposed LUPA. Relevant regulations are presented in the Regulatory Setting in Volume III. The requirements of relevant regulations would reduce impacts through the following mechanisms:

- Federal regulations (e.g., the Clean Water Act, Resource Conservation Recovery Act, Safe Drinking Water Act, and EPA Sole Source Aquifer Protection Program), state regulations (e.g., the Porter-Cologne Act, State Water Resources Control Board Anti-degradation Policy, and compliance with Waste Discharge Requirements set by the Water Boards), and ordinances administered by the various counties, municipalities, and water and wastewater agencies would limit groundwater quality impacts. Underground Injection Control permits, designed to prevent contamination and protect groundwater and drinking water sources from wastewater injection, would limit impacts from brine injection wells.
- The "Law of the River" for Colorado River Water accounting, the Wild & Scenic Rivers Act, and Watermasters in adjudicated groundwater basins would limit impacts to groundwater storage depletion. Urban Water Management Plans and Groundwater Management Plans also regulate groundwater uses.

Typical Mitigation Measures

Mitigation measures adopted for approved projects are assumed to be the same as those applied in the No Action Alternative. These mitigation measures can include:

- Groundwater Level, Quality, and Subsidence Monitoring, Mitigation, and Reporting Plans. These plans provide detailed methodologies for monitoring background and site conditions. The primary monitoring objective is to establish pre-project groundwater levels, water quality, and land surface elevations and trends in order to compare those factors with observed changes from project construction and operations. These plans can include Mitigation Action Plans to identify thresholds of significance and actions taken if thresholds are reached.
- Water Supply Assessments. These plans determine the groundwater available for project use. The plans include groundwater budget assessments based on numerical groundwater flow models, statistical analyses, and other hydrologic assessments, to determine available groundwater and to estimate potential impacts. The plans can include Drought Water Management Programs and Water Conservation Education Programs that describe how water will be managed and used during droughts. These plans can require mitigation for groundwater use by reducing pre-existing

uses in the basin (e.g., increased conservation or transfers of formally permitted water uses), reducing project use (e.g., requiring the best available technology to minimize water use, like dry cooling technology), or providing an alternative supply (e.g., imported water, recycled water). Measures to improve groundwater recharge under project conditions can include, for example, the installation of pervious groundcover to ensure maximum percolation of rainfall, and on-site drainage improvements that direct drainage from impervious surfaces to a common pervious drainage basin to maximize groundwater basin recharge.

- Installing metering devices to measure and report water use, and setting prescribed limits on groundwater use during construction and operations. These water-use restrictions can include pumping reductions when impact thresholds are reached.
- Compensating well owners impacted by project groundwater use, including compensation for increased power costs, well modifications and repair, and well replacement.
- Monitoring groundwater-dependent vegetation, springs, and wildlife within areas potentially affected by groundwater pumping.
- Monitoring brine ponds to prevent leaks and groundwater quality impacts and monitoring emergency plans for accidental geothermal brine or heat transfer fluid spillage and subsequent treatment.

IV.6.3.1.2 Impacts of Ecological and Cultural Conservation and Recreation Designations

The No Action Alternative has no new conservation or recreation designations, but without approval of an action alternative, there would be continued protection of existing LLPAs like wilderness areas. In addition, under the No Action Alternative, renewable energy projects would continue to be evaluated and approved with project-specific mitigation requirements.

Renewable energy development is excluded from existing LLPAs, reducing potential impacts on groundwater. Impacts on existing protected lands under the No Action Alternative could result from adjacent renewable energy development. Potential impacts would be influenced by the size of the developed area, the water required by the development, and the characteristics of the basins where the projects are developed.

IV.6.3.1.3 Impacts of Transmission Outside the DRECP Area

Outside the DRECP area, additional transmission lines would be needed to deliver generated renewable electricity to load centers (areas of high demand). It is assumed that new transmission lines outside the DRECP area would use existing transmission corridors between the DRECP area and existing substations in the more populated coastal areas of the state. The load centers outside the DRECP area through which new transmission lines might be constructed are San Diego, Los Angeles, North Palm Springs–Riverside, and Central Valley. These areas are described in Chapter III.6, Groundwater, Water Supply, and Water Quality, Section III.6.9.

Impact GW-1: Construction of Plan components could alter groundwater recharge.

Transmission lines would not alter groundwater recharge. Transmission towers have small footprints and their footings introduce minimal impervious surface. Access roads would be either existing paved roads or unpaved roads and would not alter the amount of impervious surface in an area. Where the terrain requires leveling, runoff is controlled by implementation of erosion control and site restoration, and the runoff would not be diverted in a way that would not allow recharge.

Impact GW-2: Groundwater consumption lowers groundwater levels, depletes water supplies, and affects groundwater quality and groundwater discharge.

The only substantial potential use of water during transmission line construction would be for dust control. The usual practice is that construction contractors obtain water for this purpose from a municipal source with adequate supplies and are prohibited from pumping groundwater.

Other groundwater, water supply, and water quality impacts identified for renewable energy development follow:

- Impact GW-3: Groundwater consumption could cause land subsidence and permanently decrease storage capacity.
- Impact GW-4: Groundwater consumption could cause existing poor-quality groundwater to migrate.
- Impact GW-5: Injection of water for geothermal steam generation could contaminate potable water supplies.
- Impact GW-6: Chemical spills or brine disposal could contaminate groundwater.

These impacts would not occur as a result of transmission projects outside the DRECP area. There would be no groundwater pumping or use, and no water injection; the risk of chemical spills would be solely from vehicle maintenance and fueling. If these occurred they would be localized and requirements imposed on the project would require immediate clean-up and disposal of any contaminated soil.

IV.6.3.2 Preferred Alternative

IV.6.3.2.1 Impacts of Renewable Energy and Transmission

The Preferred Alternative balances biological and nonbiological resource conflicts and renewable energy goals. DFAs are areas where renewable energy and transmission projects are permitted on BLM lands under the Proposed LUPA. They provide moderate development flexibility, have moderate resource conflicts (biological and nonbiological), and are aligned with existing and planned transmission networks. Transmission development may also occur outside the DFAs. The estimated renewable energy development patterns are:

- Solar development throughout the DRECP area, but concentrated in the Cadiz Valley and Chocolate Mountains, Imperial Borrego Valley, and West Mojave and Eastern Slopes ecoregion subareas
- Wind development distributed mostly in the Cadiz Valley and Chocolate Mountains ecoregion subarea
- Geothermal development in the Imperial Borrego Valley and Owen's River Valley ecoregion subareas

Impact Assessment

Potential renewable energy development on BLM lands within DRECP ecoregion subareas under the Preferred Alternative is shown in Table IV.6-2 (solar only, geothermal only, and total renewable energy development for all technologies, including wind and transmission). Development would occur in 24 groundwater basins within these subareas. Most (90%) of the developed area is within four ecoregion subareas: Cadiz Valley and Chocolate Mountains, Imperial Borrego Valley, Pinto Lucerne Valley and Eastern Slopes, and West Mojave and Eastern Slopes ecoregion subareas. Geothermal projects would be in the Imperial Borrego Valley and Owens River Valley ecoregion subareas; 86% of geothermal development is in the Imperial Borrego Valley. The Piute Valley and Sacramento Mountains subarea has no new development under the Preferred Alternative.

Table IV.6-2 shows the estimated total of new water use by solar and geothermal projects within each ecoregion subarea for the Preferred Alternative. Total water use was calculated using the projected megawatt distribution and water use factors as described in Section IV.6.1, Approach to Impact Analysis. The water use shown in Table IV.6-2 assumes that dry-cooled solar thermal technology will be used because of water scarcity in the desert basins. The estimated total water use is 44,000 ac-ft/yr, and in the subareas with proposed new development ranges from a minimum of 10 ac-ft/yr (Kingston and Funeral Mountains ecoregion subarea) to 37,000 ac-ft/yr (Imperial Borrego Valley ecoregion subarea). Eightyfour-percent of the estimated water use under the Preferred Alternative is in the Imperial Borrego Valley ecoregion subarea because of 6,000 acres of geothermal projects and 9,000 acres of solar projects. Wet-cooled geothermal projects account for over 42,000 ac-ft/yr of total water used under the Preferred Alternative.

Under the Preferred Alternative, renewable energy development can be located in a number of groundwater basins identified as in overdraft or as stressed. Figure IV.6-1 maps the distribution of estimated water use by DFA and groundwater basins in overdraft, and Figure IV.6-2 maps the water use by DFA and groundwater basins in overdraft or stressed conditions. Under the Preferred Alternative, development could occur in 15 overdraft and stressed groundwater basins, and the increased groundwater use in these sensitive basins can adversely affect water supplies and exacerbate impacts associated with overdraft conditions and declining groundwater levels.

Under the Preferred Alternative, there would be renewable energy development in basins hydraulically connected to adjacent areas located outside the DRECP area. (See Figure IV.6-1 for the locations and distribution of development areas.) Renewable energy projects are planned in groundwater basins connected to areas within the State of Nevada (the Mesquite Valley basin, located in the Kingston and Funeral Mountains ecoregion subarea), Mexico (the Imperial Valley Basin, located in the Imperial Borrego Valley ecoregion subarea), and Arizona (the Palo Verde Mesa Basin located in the Cadiz Valley and Chocolate Mountain ecoregion subarea). As a result, groundwater level and water supply changes can extend across these boundaries and impact areas outside both the DRECP area and the Colorado River.

Table IV.6-2
Renewable Energy Development Area and Estimated Water Use: Preferred Alternative

Ecoregion Subarea	Renewable Energy Development Focus Area (acres)			MW	Water Use (AFY)
	Solar	*Geothermal*	*Total*		
Cadiz Valley and Chocolate Mountains	16,000	0	22,000	3,000	800
Imperial Borrego Valley	9,000	6,000	20,000	2,000	37,000
Kingston and Funeral Mountains	100	0	100	20	10
Mojave and Silurian Valley	300	0	3,000	50	20
Owens River Valley	500	1,000	1,000	300	6,000
Panamint Death Valley	2,000	0	2,000	300	100
Pinto Lucerne Valley and Eastern Slopes	2,000	0	5,000	500	80
Piute Valley and Sacramento Mountains	0	0	0	0	0
Providence and Bullion Mountains	600	0	800	100	30

Table IV.6-2
Renewable Energy Development Area and Estimated Water Use: Preferred Alternative

Ecoregion Subarea	Renewable Energy Development Focus Area (acres)			MW	Water Use (AFY)
	Solar	*Geothermal*	*Total*		
West Mojave and Eastern Slopes	8,000	0	16,000	1,000	400
Total	**38,000**	**7,000**	**70,000**	**8,000**	**44,000**

Total megawatts for all technologies combined using the energy generation described in Appendix O (Methods for Megawatt Distribution).
Estimated solar thermal water use included industrial processes (0.5 ac-ft/yr/MW) and cooling (minimum estimate of 1 ac-ft/yr/MW represented by dry-cooled technology); photovoltaic water use for cleaning (0.05 ac-ft/yr/MW), and geothermal water use for cooling (assumed wet-cooled technology at 31 ac-ft/yr/MW); water use for wind assumed negligible.
Total development area is the sum of solar, geothermal, wind, and transmission project areas. Note that transmission acres include transmission only within groundwater basins.
Note: The following general rounding rules were applied to calculated values: values greater than 1,000 were rounded to the nearest 1,000; values less than 1,000 and greater than 100 were rounded to the nearest 100; values of 100 or less were rounded to the nearest 10, and therefore totals may not sum due to rounding. In cases where subtotals are provided, the subtotals and the totals are individually rounded. The totals are not a sum of the rounded subtotals; therefore the subtotals may not sum to the total within the table.

The Proposed LUPA alternative designates new NLCS lands, new ACECs and wildlife allocations. It also expands and reduces existing ACECs, designates new SRMAs and expands and reduces existing SRMAs, and creates buffer corridors along National Scenic and Historic Trails. The Proposed LUPA would also replace the multiple-use classes (MUCs) and establishes Visual Resource Management (VRM) classes in the CDCA. More than 5.6 million acres are assumed allocated in LUPA land designations under the Preferred Alternative. Because the BLM LUPA land designations protect ecological, historic, cultural, scenic, scientific, and recreation resources and values, the use of or access to groundwater resources to meet renewable energy project water requirements would likely be limited. Groundwater-related CMAs apply and are protective of the resource, and the CMAs are the same for all action alternatives.

Under the proposed BLM LUPA, the only changes outside the DRECP area would be to National Landscape Conservation System (NLCS) lands, ACECs, National Scenic and Historic Trails management corridors, Visual Resource Management (VRM) Classes, and to new land allocations to replace Multiple Use Classes on CDCA lands. The estimated acreage of groundwater basins in BLM LUPA lands located outside the DRECP area under the Preferred Alternative is summarized in Table R2.6-3 (Appendix R2). Because the BLM LUPA land designations outside the DRECP area protect ecological, historic, cultural, scenic, scientific, and recreation resources and values, the use of or access to groundwater resources to meet renewable energy project water requirements would be limited.

Impacts on groundwater resulting from renewable energy development under the Preferred Alternative follow.

Impact GW-1: Construction of Plan components could alter groundwater recharge.

Impacts on groundwater recharge from land disturbance under the Preferred Alternative would be similar to those shown in Section IV.6.3.1.1. The Preferred Alternative potentially affects recharge on 70,000 acres.

Impact GW-2: Groundwater consumption lowers groundwater levels, depletes water supplies, and affects groundwater quality and groundwater discharge.

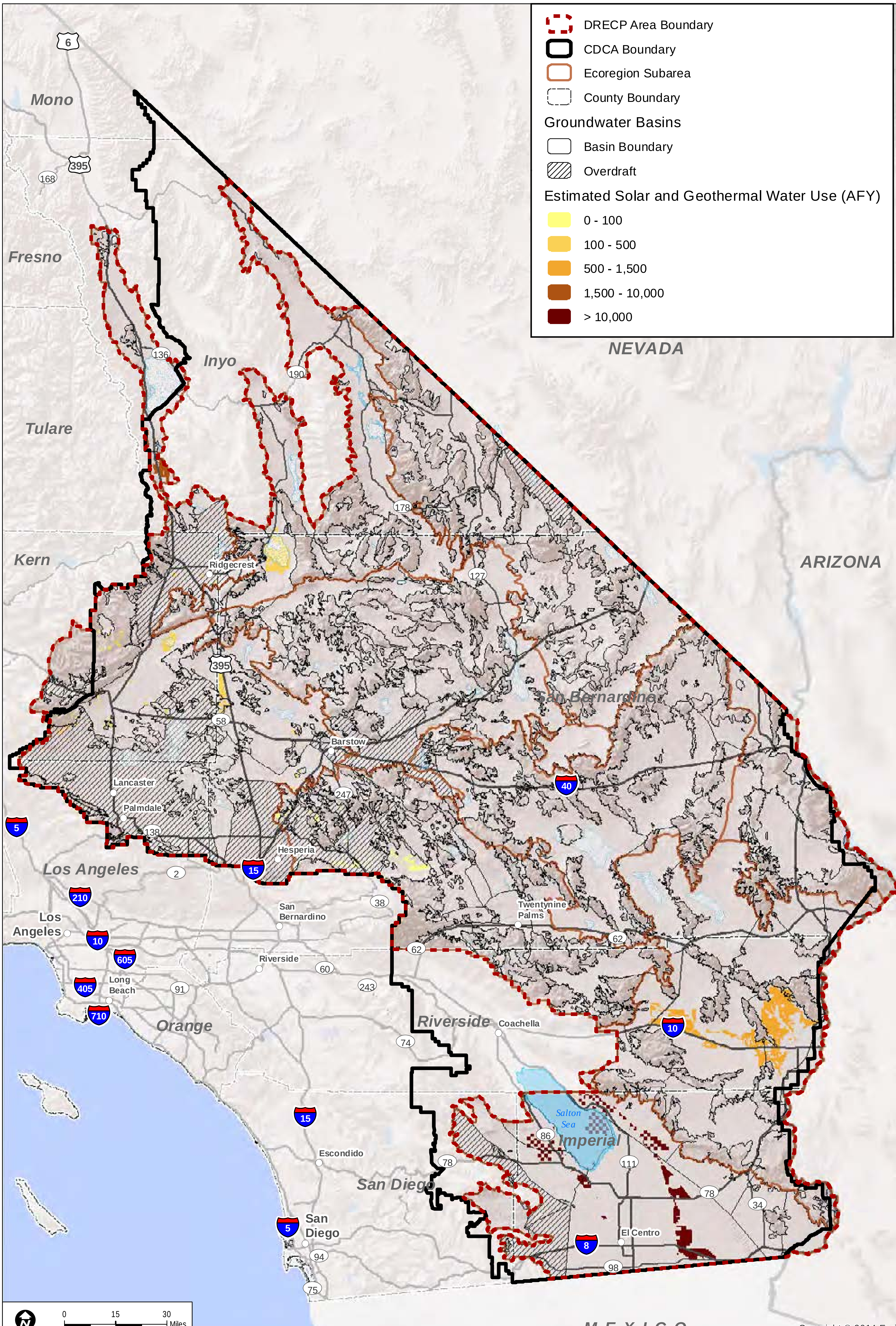
Impacts on groundwater levels would be similar to those shown in Section IV.6.3.1.1. The greatest potential water use is within the Imperial Borrego Valley (37,000 ac-ft/yr) and Owens River Valley (6,000 ac-ft/yr), mostly for geothermal technology (7,000 acres) and solar technology (9,500 acres). The majority of the remaining water use for the Preferred Alternative is for solar technology located in the Cadiz Valley and Chocolate Mountains, and West Mojave and Eastern Slopes ecoregion subareas. Fifteen basins within these ecoregion subareas are either in overdraft or characterized as stressed (Figure IV.6-2), and groundwater use for proposed renewable energy projects will likely exacerbate depletion of the water supply and the magnitude and scope of adverse impacts.

Impact GW-3: Groundwater consumption could cause land subsidence and permanently decrease storage capacity.

Land subsidence would cause impacts similar to those shown in Section IV.6.3.1.1. As shown in Table IV.6-2, renewable energy water use under the Preferred Alternative can be as great as 44,000 ac-ft/yr, with most of the water use attributed to geothermal and solar development in the Imperial Borrego Valley (37,000 ac-ft/yr) and Owens River Valley (6,000 ac-ft/yr).

Impact GW-4: Groundwater consumption could cause existing poor-quality groundwater to migrate.

Impacts from the potential migration of poor-quality groundwater would be similar to those shown in Section IV.6.3.1.1. The large amount of renewable energy development could affect groundwater quality.



Sources: ESRI (2014); California Department of Water Resources (2003)

FIGURE IV.6-1

Planned Development Areas, Estimated Solar and Geothermal Water Use, and Overdraft Groundwater Basins - Preferred Alternative

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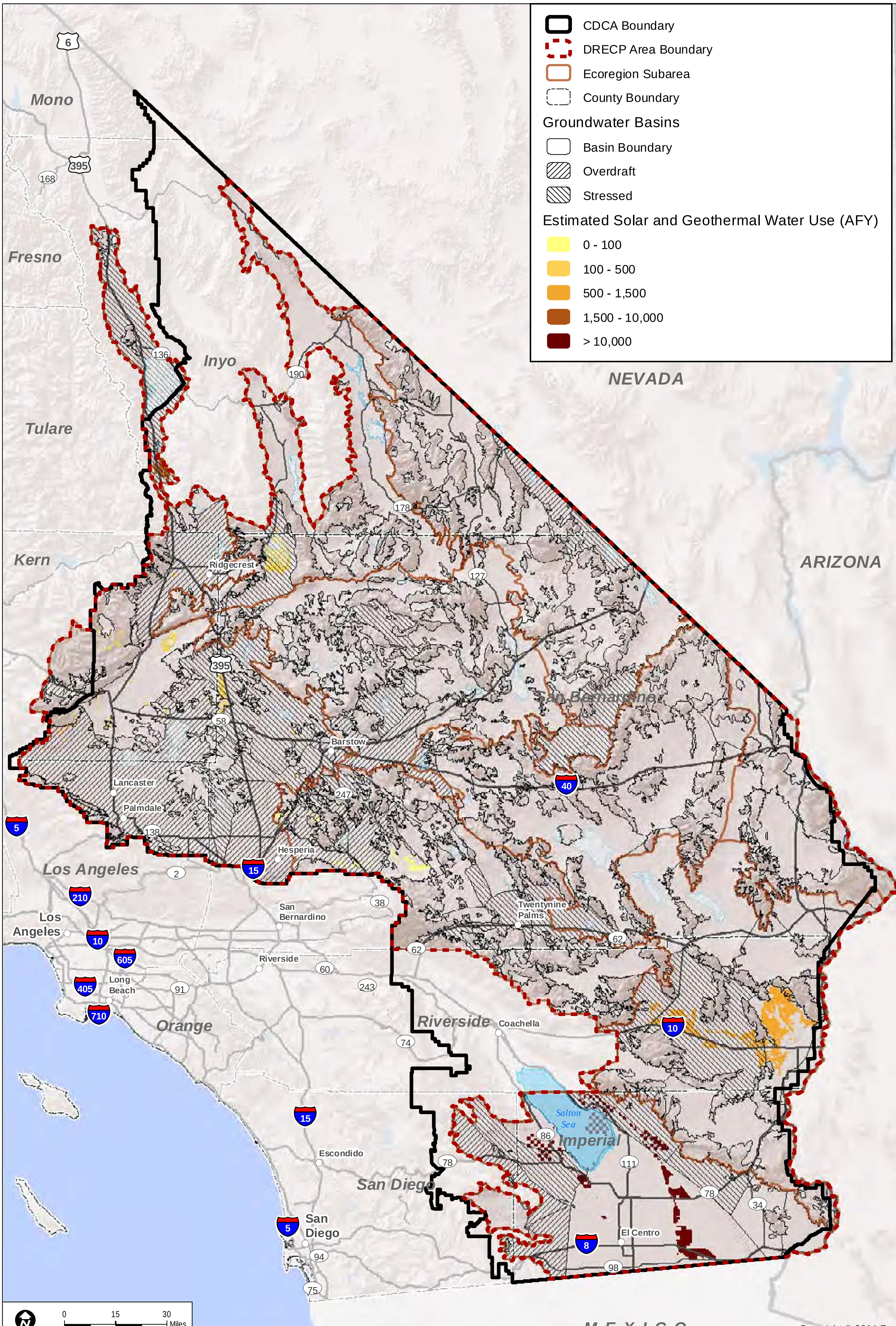

Sources: ESRI (2014); California Department of Water Resources (2003)

FIGURE IV.6-2

Planned Development Areas, Estimated Solar and Geothermal Water Use, and Overdraft and Stressed Groundwater Basins - Preferred Alternative

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Impact GW-5: Injection of water for geothermal steam generation could contaminate potable water supplies.

The potential for impacts from injection of saline water from geothermal resource water would be as described in Section IV.6.3.1.1. Geothermal development increases the potential for contamination, particularly in the Imperial Borrego Valley ecoregion subarea where most of the geothermal development would be built.

Impact GW-6: Chemical spills or brine disposal could contaminate groundwater.

Groundwater contamination from chemical spills or brine disposal would be as described in Section VI.6.3.1.1.

Impacts on Variance Process Lands

Variance Process Lands are neither reserve lands nor DFAs. They are a subset of the variance lands identified in the Solar PEIS Record of Decision (ROD) and additional lands that, based on current information, have moderate to low ecological value and ambiguous value for renewable energy. If renewable energy development occurs on Variance Process Lands, a LUPA would not be required, so the environmental review process would be simpler than if the location were left undesignated.

Variance Process Lands for each alternative are shown in Chapter IV.1, Table IV.1-2, and in Volume II, Chapter II.3, Figure II.3-1, for the Preferred Alternative. Development of Variance Process Lands would have similar air quality effects as described under Impacts GW-1 through GW-6.

Impact Reduction Strategies

Design Features of the Solar PEIS

The Solar PEIS includes Design Features (Appendix W) that would reduce the impacts of solar energy development, including: measures to control runoff (defined in WR1-1), measures to quantify groundwater aquifers and sustainable yield (defined in WR1-2), measures to secure a reliable and legally available water supply (defined in WR1-3), and impact reduction measures (defined in WR2-1, WR3-1, and WR4-1 for construction, operation, and decommissioning, respectively). These measures would apply only in BLM SEZs and Solar PEIS variance lands.

Conservation and Management Actions

The conservation strategy for the Preferred Alternative (presented in Volume II, Section II.3.4) defines specific actions that would reduce the impacts of this alternative. The conservation strategy includes a definition of the conservation designations and specific Conservation and Management Actions (CMAs) for the Preferred Alternative. The CMAs require a Water Supply Assessment for all projects. The purpose of the Water Supply Assessment is to determine whether project groundwater use causes water supply or environmental impacts on the groundwater basins where the development occurs. The assessment evaluates existing extractions, water rights, and water management plans, and requires site- and basin-specific hydrogeological information.

The CMAs require Water Monitoring and Reporting Plans and Mitigation Action Plans. These plans identify project-related impacts on water quantity and quality affecting other approved domestic or industrial groundwater uses and the environmental requirements for groundwater (e.g., surface water bodies, surface outflow, and riparian or phreatic vegetation), including the period of aquifer recovery after project decommissioning. The plans also detail mitigation measures required because of project-related impacts on groundwater. These measures can include changing pumping rates and the volume or timing of withdrawals, coordinating and scheduling groundwater pumping activities in conjunction with other users in the basin, ceasing pumping and acquiring project water from outside the basin, and replenishing groundwater resources over a reasonably short time frame.

The CMAs are summarized here and presented in detail in Volume II, Section II.3.4.2. For any project that proposes to utilize groundwater resources, the following stipulated CMAs shall apply, regardless of project location:

- **LUPA-SW-18** A project's groundwater extraction shall not contribute to exceeding the estimated perennial yield for the basin in which the extraction is taking place. Exceeding a basin's perennial yield can have undesirable effects on the basin's physical and chemical condition. It is further quantified arithmetically in CMA LUPA-SW-24.
- **LUPA-SW-19** Water extracted or consumptively used for the construction, operation, maintenance, or remediation of the project shall be solely for the beneficial use of the project or its associated mitigation and remediation measures. This assures that water is not used for purposes not directly related to the project.
- **LUPA-SW-20** Water flow meters shall be installed on all extraction wells permitted by BLM. This will provide information needed to develop a detailed water budget for the project area.

- **LUPA-SW-21** If possible, all unavoidable impacts on surface waters shall be mitigated to ensure no net negative impact to the surface water from project implementation.
- **LUPA-SW-22** Consideration shall be given to design alternatives that maintain the existing hydrology of the site or redirect excess flows created by hardscapes and reduced permeability from surface waters to areas where they will dissipate by percolation into the landscape.
- **LUPA-SW-23** Degradation of water quality will be minimized by avoiding all hydrologic alterations that could reduce water quality for all applicable beneficial uses associated with the project.
- **LUPA-SW-24** A Water (Groundwater) Supply Assessment shall be prepared prior to project certification or authorization. The purpose of the Water Supply Assessment is to determine whether over-use or overdraft conditions exist within the project basin(s), and whether the project creates or exacerbates these conditions. This analysis shall be in the form of a numerical groundwater model. The model extent shall encompass the groundwater basin(s) where a project would be built, and any groundwater-dependent resources within the groundwater basin(s).
- **LUPA-SW-25** Groundwater Monitoring and Reporting Plans, and Mitigation Action Plans (GMMP) shall be prepared to verify the Water Supply Assessment and adaptively manage water use as part of project operations.
- **LUPA-SW-26** One or more “trigger points,” or specified groundwater elevations in specific wells or surface water bodies, shall be established to identify if additional mitigation measures will be imposed.
- **LUPA-SW-27** Groundwater pumping mitigation shall be imposed if groundwater monitoring data indicate impacts on water-dependent resources that exceed those anticipated and otherwise mitigated for in the NEPA analysis and ROD, even if the basin’s perennial yield is not exceeded.
- **LUPA-SW-28** Water-conservation measures shall be required in basins where current groundwater demand is high and has the potential for demand to rise above the estimated perennial yield. These measures will assure that groundwater withdrawals do not exceed the perennial yield.
- **LUPA-SW-29** Groundwater extractions from adjudicated basins, such as the Lower, Middle, and Upper Mojave River basins, may be subject to additional restrictions imposed by the designated authority to prevent groundwater extractions in the basin from exceeding the adjudicated allotment.

- **LUPA-SW-30** Groundwater pumping mitigation may also be imposed if monitoring data indicate impacts on groundwater or groundwater-dependent habitats outside the DRECP area to prevent impacts from affecting adjacent groundwater basins.
- **LUPA-SW-31** Activities shall comply with local requirements for any permanent or temporary domestic water use and wastewater treatment.
- **LUPA-SW-32** The siting, construction, operation, maintenance, remediation, and abandonment of all wells shall conform to specifications contained in Department of Water Resources (DWR) Bulletins #74-81 and #74-90 and their updates.
- **LUPA-SW-33** The Colorado River accounting surface method shall be the accepted method of determining whether project-related pumping may draw water from the Colorado River. The project applicant will be required to offset or otherwise mitigate the volume of water causing drawdown below the accounting surface.

<u>Soil, Water, and Water-Dependent Resources CMAs Restricted to Specific Areas on BLM Lands</u>

- **LUPA-SW-34 Stipulations for groundwater development in the proximity of Devils Hole:** Any development scenario within 25 miles of Devils Hole shall include a plan to achieve *zero-net* or *net-reduced* groundwater pumping to reduce the risk of adversely affecting senior federal reserved water rights, the designated critical habitat of the endangered Devils Hole pupfish, and the free-flowing requirements of the Wild and Scenic Amargosa River.
- **LUPA-SW-35 Stipulations for groundwater development in the Calvada Springs/ South Pahrump Valley DFA:** Activities in this DFA shall be required to acquire one or more MWRs in the Pahrump Valley Hydrographic Basin in Nevada.
- **LUPA-SW-36 Stipulations for development in the vicinity of Death Valley National Park, Joshua Tree National Park, or Mojave National Preserve:** The National Environmental Policy Act (NEPA) requirements for activities involving groundwater extraction in the vicinity of Death Valley National Park, Joshua Tree National Park, or the Mojave National Preserve shall analyze and address any potential impacts of groundwater extraction on these parks and preserve. This analysis will identify potential impacts on the water balances and physical conditions of groundwater basins, springs, perennial streams, intermittent streams, and ephemeral drainages within these parks and preserves.

Laws and Regulations

Existing laws and regulations would further reduce the impacts of renewable energy development projects constructed subsequent to the Proposed LUPA. Relevant regulations are presented in the Regulatory Setting in Volume III, and summarized in Section IV.6.3.1.1.

IV.6.3.2.2 Impacts of Ecological and Cultural Conservation and Recreation Designations

The estimated acres of groundwater basins in Ecological and Cultural Conservation and Recreation Designation lands are summarized in Table R2.6-4 (Appendix R2). These lands include existing protected areas (LLPAs and Military Expansion Mitigation Lands [MEMLs]), plus the Preferred Alternative existing and proposed BLM conservation lands (NLCS, ACECs, and wildlife allocations). No renewable energy development is allowed on almost 8.1 million acres of these protected areas, nor is the use of or access to underlying groundwater. This includes more than 3.5 million acres within 37 groundwater basins identified as either in overdraft or stressed. No adverse impacts are expected to groundwater resources in these basins because of these land designations, and restricting renewable energy development from these areas would protect and preserve groundwater.

IV.6.3.2.3 Impacts of Transmission Outside the DRECP Area

The impacts of transmission outside the DRECP area on groundwater, water supply, and water quality would be the same under all alternatives. These impacts are as described for the No Action Alternative in Section IV.6.3.1.3, Impacts of Transmission Outside the DRECP Area, in the No Action Alternative.

IV.6.3.2.4 Comparison of the Preferred Alternative with No Action Alternative

Based on technology mix assumptions, the Preferred Alternative includes proposed development of 28,000 acres less area than in the No Action Alternative (70,000 acres versus 98,000 acres, respectively). This decreased level of land disturbance associated with development decreases the potential to alter groundwater recharge. Under the Preferred Alternative, the potential for chemical spills and groundwater quality impacts is less because the developed area is smaller. However, existing regulations and CMAs (Preferred Alternative) reduce these potential impacts in both alternatives.

In the Preferred Alternative, it is assumed that there would be 17 times more acreage for geothermal energy projects than in the No Action Alternative, increasing potential adverse impacts from water consumption, subsidence, and groundwater contamination. However, with existing regulations, implementation of CMAs, and additional measures required for renewable energy projects, these impacts would be mitigated.

Renewable energy projects in the Preferred Alternative are estimated to use seven times more water than under the No Action Alternative, primarily due to greater geothermal development under the Preferred Alternative.

Geographic Distinctions

Unlike in the Preferred Alternative, in the No Action Alternative renewable energy development is assumed in the Providence and Bullion Mountains ecoregion subarea. Under existing conditions, more than 99% of the basin area within this ecoregion subarea is undisturbed and has no existing renewable energy development.

Solar and geothermal technologies account for most renewable energy-related water use, so the locations of these projects are important to consider. The No Action Alternative assumes over 62,000 acres of solar and geothermal development in 25 of the 39 overdraft or stressed basins in other portions of the DRECP area; the Preferred Alternative assumes 45,000 acres of development in only 14 of the same 39 basins (Figure IV.6-2). The Preferred Alternative therefore has more concentrated development in a fewer number of overdraft and stressed basins.

Under the Preferred Alternative, renewable energy projects could occur in groundwater basins connected to areas adjacent to the DRECP area. These areas are located in the State of Nevada (the Pahrump Valley Basin located in the Kingston and Funeral Mountains ecoregion subarea), Mexico (the Imperial Valley Basin, located in the Imperial Borrego Valley ecoregion subarea), and Arizona (Palo Verde Valley Basin, located in the Cadiz Valley and Chocolate Mountain ecoregion subarea). Groundwater level and water supply changes can therefore extend across these boundaries and impact areas outside the DRECP area including the Colorado River. For example, the Pahrump Valley Basin is in overdraft (Figure IV.6-1) due to development in Nevada. Groundwater flow in the deep limestone formations occurs from the Pahrump Valley and Spring Mountains in Nevada to the Middle Amargosa Valley Basin. Past pumping in the Nevada portion of the basin may have reduced flow from springs in the Middle Amargosa Valley Basin. However, the mechanism of hydraulic connection between groundwater in the alluvial basin and deep groundwater in the regional carbonate aquifer system (and their relative contributions to Amargosa River flows and spring flows) is complicated and poorly understood. Development within the Pahrump Valley Basin must therefore consider these possible connections when identifying and quantifying potential impacts.

In comparison with the Preferred Alternative, the No Action Alternative could affect more areas located outside the LUPA Decision Area. For example, Table IV.6-1 shows that the No Action Alternative has more development in the Kingston and Funeral Mountains ecoregion subarea located adjacent to the State of Nevada. Groundwater in deep limestone formations beneath these areas can flow to springs along the east side of the Death Valley Basin (e.g., the Greenwater Valley and Middle Amargosa Valley basins). Development under the Preferred Alternative is less or nonexistent in these sensitive basins and provides an overall environmental benefit relative to the No Action Alternative.

IV.6.3.3 Alternative 1

IV.6.3.3.1 Impacts of Renewable Energy and Transmission

Alternative 1 integrates renewable energy components, BLM LUPA components, and the conservation components of the DRECP Preferred Alternative. Alternative 1 includes geographically confined DFAs with development of solar, wind, and geothermal technologies on BLM lands. It also includes Ecological and Cultural Conservation and Recreation Designations. Transmission development and operation would be acceptable both inside and outside the DFAs. The estimated renewable energy development pattern emphasizes the following:

- Solar development in the Cadiz Valley and Chocolate Mountains, Imperial Borrego Valley, Owens River Valley, Pinto Lucerne Valley and Eastern Slopes, and West Mojave and Eastern Slopes ecoregion subareas.
- Wind development in the Cadiz Valley and Chocolate Mountains, Pinto Lucerne Valley and Eastern Slopes ecoregion subareas.
- Geothermal development in the Imperial Borrego Valley ecoregion subarea.

Impact Assessment

Potential renewable energy development area on BLM lands within the DRECP area under Alternative 1 is shown in Table IV.6-3 (solar only, geothermal only, and total renewable energy development for all technologies, including wind and transmission). Development would occur in 24 groundwater basins. Most of the developed area (81%) is within four ecoregion subareas: Cadiz Valley and Chocolate Mountains, Imperial Borrego Valley, Pinto Lucerne Valley and Eastern Slopes, and West Mojave and Eastern Slopes. Geothermal projects are only in the Imperial Borrego Valley ecoregion subarea. Three ecoregion subareas (Kingston and Funeral Mountains, Panamint Death Valley, and Piute Valley and Sacramento Mountains) have no planned development under Alternative 1.

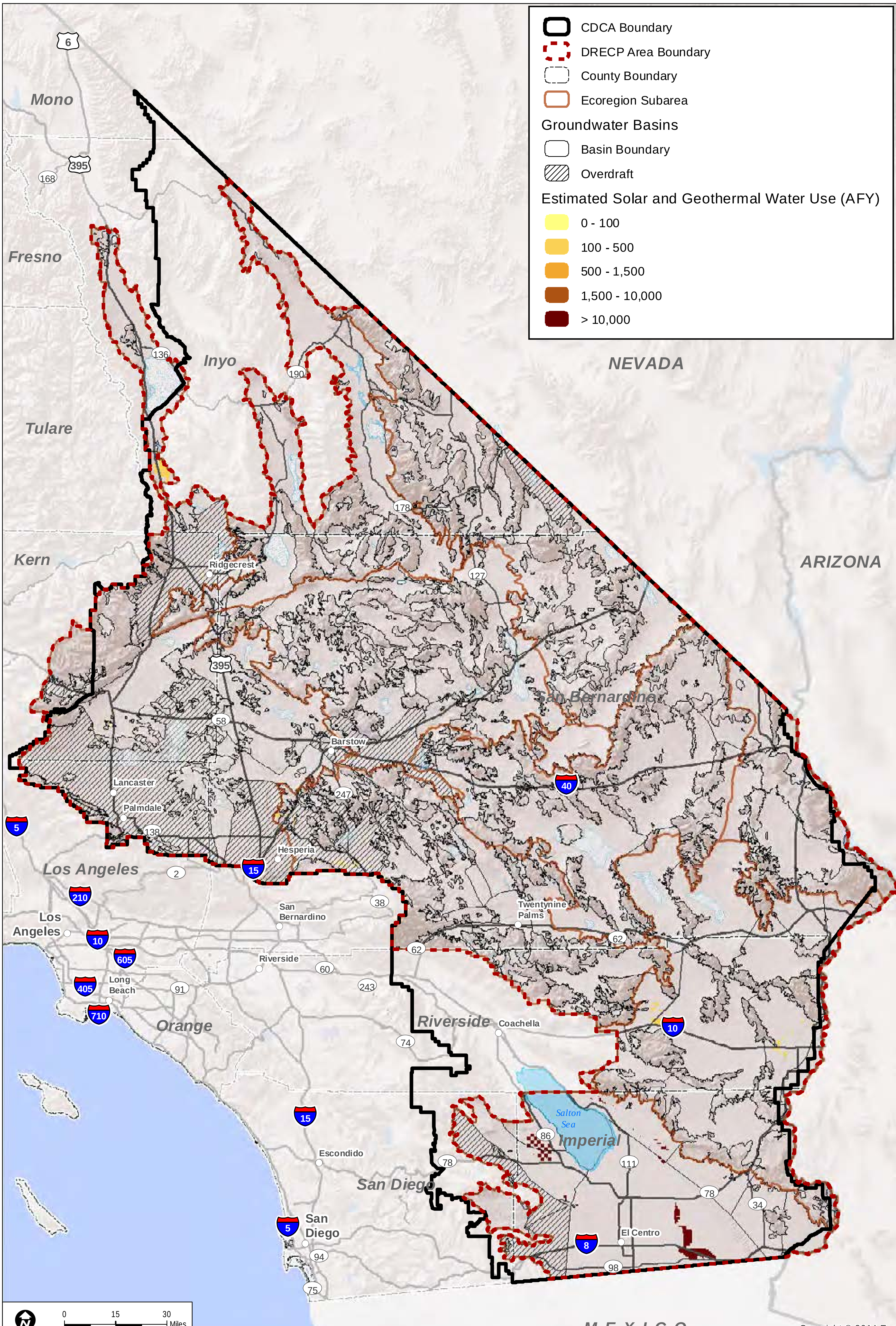
Table IV.6-3 shows the estimated total new water use by solar and geothermal projects within each ecoregion subarea. Total water use was calculated using the projected megawatt distribution and water use factors described in Section IV.6.1, Approach to Impact Analysis. The water use shown in Table IV.6-2 was estimated assuming that dry-cooled solar thermal technology will be used because of the scarce water resources in the desert basins. Estimated total use is 29,000 ac-ft/yr, and ranges from a minimum of 20 ac-ft/yr (Providence and Bullion Mountains ecoregion subarea) to a maximum of 28,000 ac-ft/yr (Imperial Borrego Valley ecoregion subarea). Wet-cooled geothermal projects account for most of the total water use under Alternative 1. Ninety-seven percent of the water use under Alternative 1 is in the Imperial Borrego Valley ecoregion subarea's 4,000 acres of geothermal projects and 2,000 acres of solar projects.

Under Alternative 1, renewable energy development can be built in a number of overdraft or stressed groundwater basins. Figure IV.6-3 maps the distribution of estimated water use by DFA and overdraft groundwater basins, and Figure IV.6-4 maps the water use by DFA and overdraft and stressed groundwater basins. Development occurs in 18 overdraft and stressed groundwater basins, and the increased groundwater use in these sensitive basins can adversely affect water supplies and exacerbate impacts associated with overdraft conditions and declining groundwater levels.

Table IV.6-3
Renewable Energy Development Area and Estimated Water Use – Alternative 1

Ecoregion Subarea	Renewable Energy Development Focus Area (acres)			MW	Water Use (AFY)
	Solar	*Geothermal*	*Total*		
Cadiz Valley and Chocolate Mountains	4,000	0	7,000	600	200
Imperial Borrego Valley	2,000	4,000	13,000	1,000	28,000
Kingston and Funeral Mountains	0	0	0	0	0
Mojave and Silurian Valley	0	0	3,000	30	200
Owens River Valley	4,000	0	4,000	500	200
Panamint Death Valley	0	0	0	0	0
Pinto Lucerne Valley and Eastern Slopes	2,000	0	5,000	400	100
Piute Valley and Sacramento Mountains	0	0	0	0	0
Providence and Bullion Mountains	300	0	500	40	20
West Mojave and Eastern Slopes	1,000	0	9,000	200	80
Total	**14,000**	**4,000**	**42,000**	**3,000**	**29,000**

Total megawatts for all technologies combined using the energy generation described in Appendix O (Methods for Megawatt Distribution).
Estimated solar thermal water use included industrial processes (0.5 ac-ft/yr/MW) and cooling (minimum estimate of 1 ac-ft/yr/MW represented by dry-cooled technology); photovoltaic water use for cleaning (0.05 ac-ft/yr/MW), and geothermal water use for cooling (assumed wet-cooled technology at 31 ac-ft/yr/MW); water use for wind assumed negligible.
Total development area is the sum of solar, geothermal, wind, and transmission project areas. Note that transmission acres include transmission only within groundwater basins.
Note: The following general rounding rules were applied to calculated values: values greater than 1,000 were rounded to the nearest 1,000; values less than 1,000 and greater than 100 were rounded to the nearest 100; values of 100 or less were rounded to the nearest 10, and therefore totals may not sum due to rounding. In cases where subtotals are provided, the subtotals and the totals are individually rounded. The totals are not a sum of the rounded subtotals; therefore the subtotals may not sum to the total within the table.



Sources: ESRI (2014); California Department of Water Resources (2003)

FIGURE IV.6-3

Planned Development Areas, Estimated Solar and Geothermal Water Use, and Overdraft Groundwater Basins - Alternative 1

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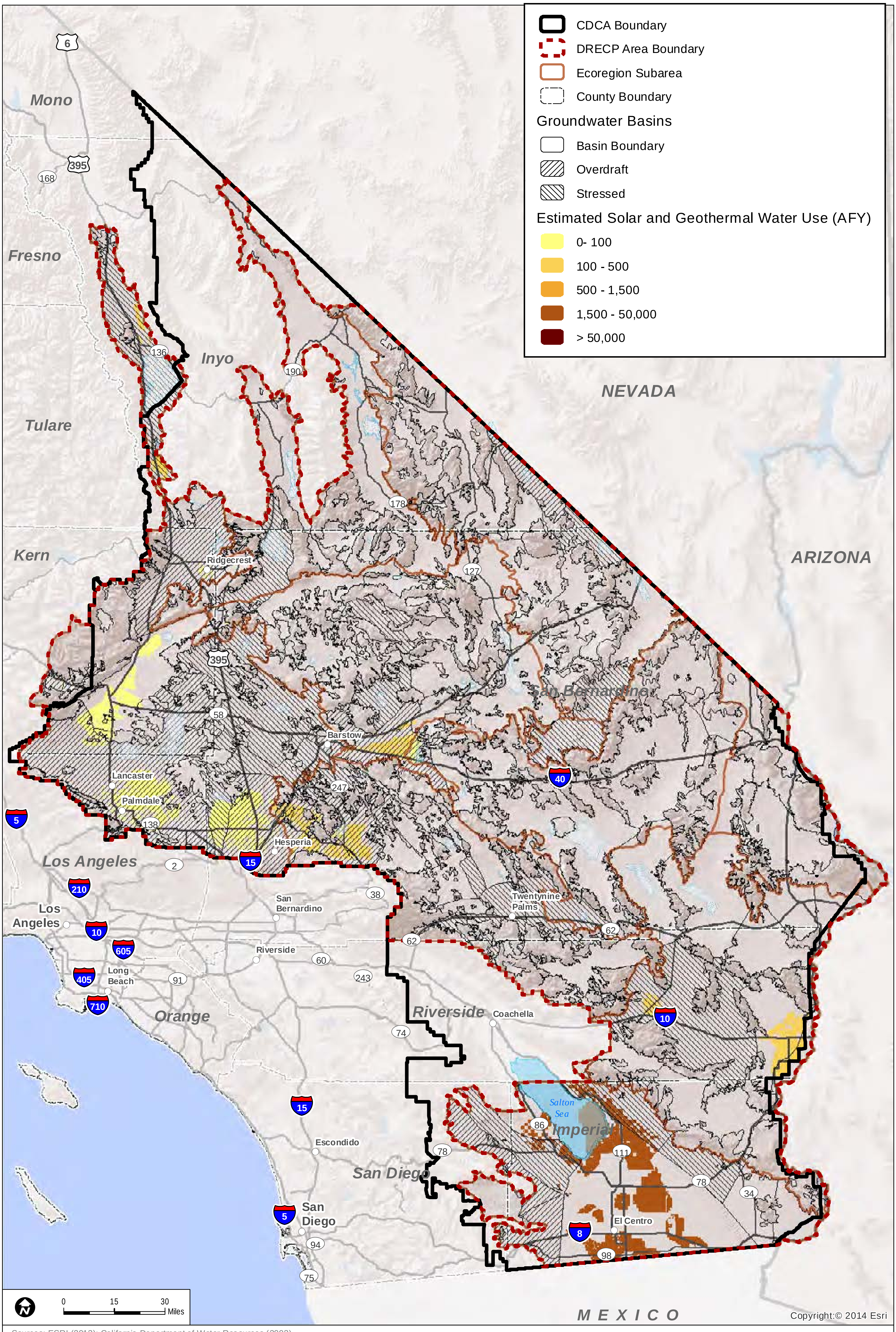

Sources: ESRI (2013); California Department of Water Resources (2003)

FIGURE IV.6-4

Planned Development Areas, Estimated Solar and Geothermal Water Use, and Overdraft and Stressed Groundwater Basins - Alternative 1

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Under Alternative 1, planned renewable energy development would be in basins hydraulically connected to adjacent areas located outside the DRECP area (See Figure IV.6-3 for the locations and distribution of development areas). Renewable energy projects occur in groundwater basins connected to areas within Mexico (the Imperial Valley Basin, located in the Imperial Borrego Valley ecoregion subarea), and Arizona (Palo Verde Valley Basin, located in the Cadiz Valley and Chocolate Mountain ecoregion subarea). Groundwater level and water supply changes can therefore extend across these boundaries and impact areas outside the DRECP area and the Colorado River.

Alternative 1 designates new NLCS lands, ACECs, and wilderness allocations, expands and reduces existing ACECs, designates new SRMAs and both expands and reduces existing SRMAs, creates buffer corridors along National Scenic and Historic Trails, and manages lands with wilderness characteristics. The BLM LUPA also replaces MUCs, and establishes VRM Classes in the California Desert Conservation Area(CDCA). More than 4.7 million acres are assumed to be in the BLM LUPA land designation under Alternative 1. Because BLM LUPA land designations protect ecological, historic, cultural, scenic, scientific, and recreation resources and values, the use of or access to groundwater resources to meet renewable energy project water requirements would be limited. Groundwater-related CMAs apply and are the same for all alternatives.

Under the proposed BLM LUPA, the only changes outside the DRECP area would be the designation of National Landscape Conservation System (NLCS) lands, ACECs, National Scenic and Historic Trails management corridors, VRM Classes, and new land allocations to replace MUCs on CDCA lands. The estimated acreage of groundwater basins in BLM LUPA lands located outside the DRECP area under the Alternative 1 is summarized in Table R2.6-5 (Appendix R2). Because BLM LUPA land designations outside the DRECP area protect ecological, historic, cultural, scenic, scientific, and recreation resources and values, the use of or access to groundwater resources to meet renewable energy project water requirements would likely be limited.

Impact GW-1: Construction of DRECP components could alter groundwater recharge.

Impacts on groundwater recharge resulting from land disturbance under Alternative 1 would be similar to those shown in Section IV.6.3.1.1. Alternative 1 potentially affects recharge on 70,000 acres.

Impact GW-2: Groundwater consumption lowers groundwater levels, depletes water supplies, and affects groundwater quality and groundwater discharge.

Impacts on groundwater levels would be similar to those shown in Section IV.6.3.1.1. The greatest potential water use is in the Imperial Borrego Valley ecoregion subarea (28,000 ac-ft/yr), mostly for geothermal technology (4,000 acres) and solar technology (2,000 acres). The remaining water use is mostly for solar technology in the Cadiz Valley and Chocolate Mountains, Mojave and Silurian Valley, Owens River Valley, Pinto Lucerne Valley and Eastern Slopes, Providence and Bullion Mountains, and West Mojave and Western Slopes ecoregion subareas. Sixteen basins within these ecoregion subareas are in overdraft or are stressed (Figure IV.6-4), and groundwater use for renewable energy projects would likely exacerbate depletion of the water supply and the magnitude and scope of adverse impacts.

Impact GW-3: Groundwater consumption could cause land subsidence and permanently decrease storage capacity.

Land subsidence would cause impacts similar to those shown in Section IV.6.3.1.1. As shown in Table IV.6-3, renewable energy water use under Alternative 1 is 29,000 ac-ft/yr, with most of the water use attributed to geothermal and solar development in the Imperial Borrego Valley ecoregion subarea.

Impact GW-4: Groundwater consumption could cause existing poor-quality groundwater to migrate.

Impacts from the potential migration of poor-quality groundwater would be similar to those shown in Section IV.6.3.1.1. The large amount of renewable energy development could affect groundwater quality.

Impact GW-5: Injection of water from geothermal steam generation could contaminate potable water supplies.

The potential for impacts from injection of saline water for geothermal steam water would be as shown in Section IV.6.3.1.1. Geothermal development increases the potential for contamination in the Imperial Borrego Valley ecoregion subarea where all of geothermal development would be located.

Impact GW-6: Chemical spills or brine disposal could contaminate groundwater.

Groundwater contamination from chemical spills or brine disposal would be as shown in Section VI.6.3.1.1.

Impacts on Variance Process Lands

Variance Process Lands are neither reserve lands nor DFAs. They are a subset of the variance lands identified in the Solar PEIS ROD and additional lands that, based on current information, have moderate to low ecological value and ambiguous value for renewable energy. If renewable energy development occurs on Variance Process Lands, a LUPA would not be required, so the environmental review process would be somewhat simpler than if the location were left undesignated.

Variance Process Lands for each alternative are as shown in Chapter IV.1, Table IV.1-2, and in Volume II, Chapter II.4, Figure II.4-1, for Alternative 1. Development of the Variance Process Lands would have similar air quality effects as described above under Impacts GW-1 through GW-6.

Impact Reduction Strategies

Design Features of the Solar PEIS

The Solar PEIS includes Design Features (Appendix W) that would reduce the impacts of solar energy development, including: measures to control runoff (defined in WR1-1), measures to quantify groundwater aquifers and sustainable yield (defined in WR1-2), measures to secure a reliable and legally available water supply (defined in WR1-3), and impact reduction measures (defined in WR2-1, WR3-1, and WR4-1 for construction, operation, and decommissioning, respectively). These measures would apply only on BLM SEZs and Solar PEIS variance lands.

Conservation and Management Actions

The conservation strategy for Alternative 1 (presented in Volume II, Section II.4.4) defines specific actions that would reduce the impacts of this alternative. The conservation strategy includes definition of the conservation designations and specific CMAs for the Preferred Alternative. The CMAs described in Section IV.6.3.2.1 apply to Alternative 1.

Laws and Regulations

Existing laws and regulations would further reduce the impacts of renewable energy development projects constructed subsequent to the Proposed LUPA. Relevant regulations are presented in the Regulatory Setting in Volume III, and summarized in Section IV.6.3.1.1.

IV.6.3.3.2 Impacts of Ecological and Cultural Conservation and Recreation Designations

The estimated acreage of groundwater basins in Ecological and Cultural Conservation and Recreation Designations is summarized in Table R2.6-6 (Appendix R2). These lands include existing protected areas (LLPAs and MEMLs) and Alternative 1 existing and proposed BLM conservation lands (NLCS lands, ACECs, and wildlife allocations). No renewable energy development is allowed in existing protected areas, and the use of or access to groundwater resources to meet renewable energy project water requirements would be limited. No adverse impacts are therefore expected to groundwater resources from the conservation and recreation designations. Under Alternative 1, renewable energy development is restricted on over 2.4 million acres within 37 overdraft or stressed groundwater basins, protecting and preserving groundwater and water supply conditions in these areas.

IV.6.3.3.3 Impacts of Transmission Outside the DRECP Area

The impacts of transmission outside the DRECP area on groundwater, water supply, and water quality would be the same under all alternatives. These impacts are as described for the No Action Alternative in Section IV.6.3.1.3, Impacts of Transmission Outside the DRECP Area, in the No Action Alternative.

IV.6.3.3.4 Comparison of Alternative 1 With Preferred Alternative

Alternative 1 would facilitate development of 28,000 acres less area for renewable energy projects than the Preferred Alternative (42,000 acres versus 70,000 acres, respectively). This lowers the potential for chemical spills and groundwater contamination, but existing regulations and BMPs would reduce potential groundwater contamination impacts in both alternatives. Renewable energy development can potentially alter groundwater recharge; but with mitigation, these changes may increase groundwater recharge (e.g., installing pervious groundcover and directing runoff flows from a greater area to percolation basins). Because the developed area is smaller under Alternative 1, there is less potential to increase groundwater recharge, relative to the Preferred Alternative.

Renewable energy projects in Alternative 1 are estimated to use less water than in the Preferred Alternative (29,000 ac-ft/yr versus 44,000 ac-ft/yr, respectively), with most of the water use for both alternatives from geothermal and solar technologies concentrated in the Imperial Borrego Valley. Existing regulations, implementation of CMAs, and additional measures required for renewable energy projects would reduce impacts under both alternatives. However, impacts from geothermal water use would remain for both the Preferred Alternative and Alternative 1.

Geographic Distinctions

Solar and geothermal technologies account for most renewable energy related water use, so the geographic locations of these projects are important to consider. Alternative 1 develops solar and geothermal projects in 18 of the 39 overdraft or stressed basins identified in the DRECP area (Figure IV.6-4); the Preferred Alternative develops projects in 15 overdraft or stressed basins (Figure IV.6-2). Alternative 1 therefore develops projects in more sensitive groundwater basins. Existing regulations, implementation of the CMAs, and additional measures required for renewable energy projects would mitigate impacts from development under both alternatives.

Under Alternative 1, no development is proposed in the Kingston and Funeral Mountains, Panamint Death Valley, and Piute Valley and Sacramento Mountains ecoregion subareas. Two of these ecoregion subareas (Kingston and Funeral Mountains and Panamint Death Valley) have proposed development under the Preferred Alternative. Under Alternative 1 there is no developed area adjacent to Nevada and the developed area is smaller adjacent to Mexico and Arizona (the Imperial Valley and Palo Verde Valley basins, respectively), reducing the potential for groundwater level and water supply changes that extend across their boundaries and impact areas outside the DRECP area, including the Colorado River.

IV.6.3.4 Alternative 2

IV.6.3.4.1 Impacts of Renewable Energy and Transmission

Alternative 2 integrates renewable energy components, BLM LUPA components, and other conservation components of the DRECP Preferred Alternative. It includes geographically dispersed and maximized DFAs on BLM lands with expanded wind opportunities. The estimated renewable energy development pattern emphasizes:

- Dispersed solar and wind development.
- Geothermal development in two ecoregion subareas: Imperial Borrego Valley and Owens River Valley.

Impact Assessment

Potential renewable energy development on BLM lands within the DRECP area under Alternative 2 is shown in Table IV.6-4 (solar only, geothermal only, and total renewable energy development for all technologies, including wind and transmission). Development would be in 36 groundwater basins. Most (81%) of the developed area is within three ecoregion subareas: Cadiz Valley and Chocolate Mountains, Imperial Borrego Valley, and West Mojave and Eastern Slopes. Geothermal projects are in the Imperial Borrego Valley and Owens River Valley ecoregion subareas. One ecoregion subarea, Piute Valley and Sacramento Mountains, has no development under Alternative 2.

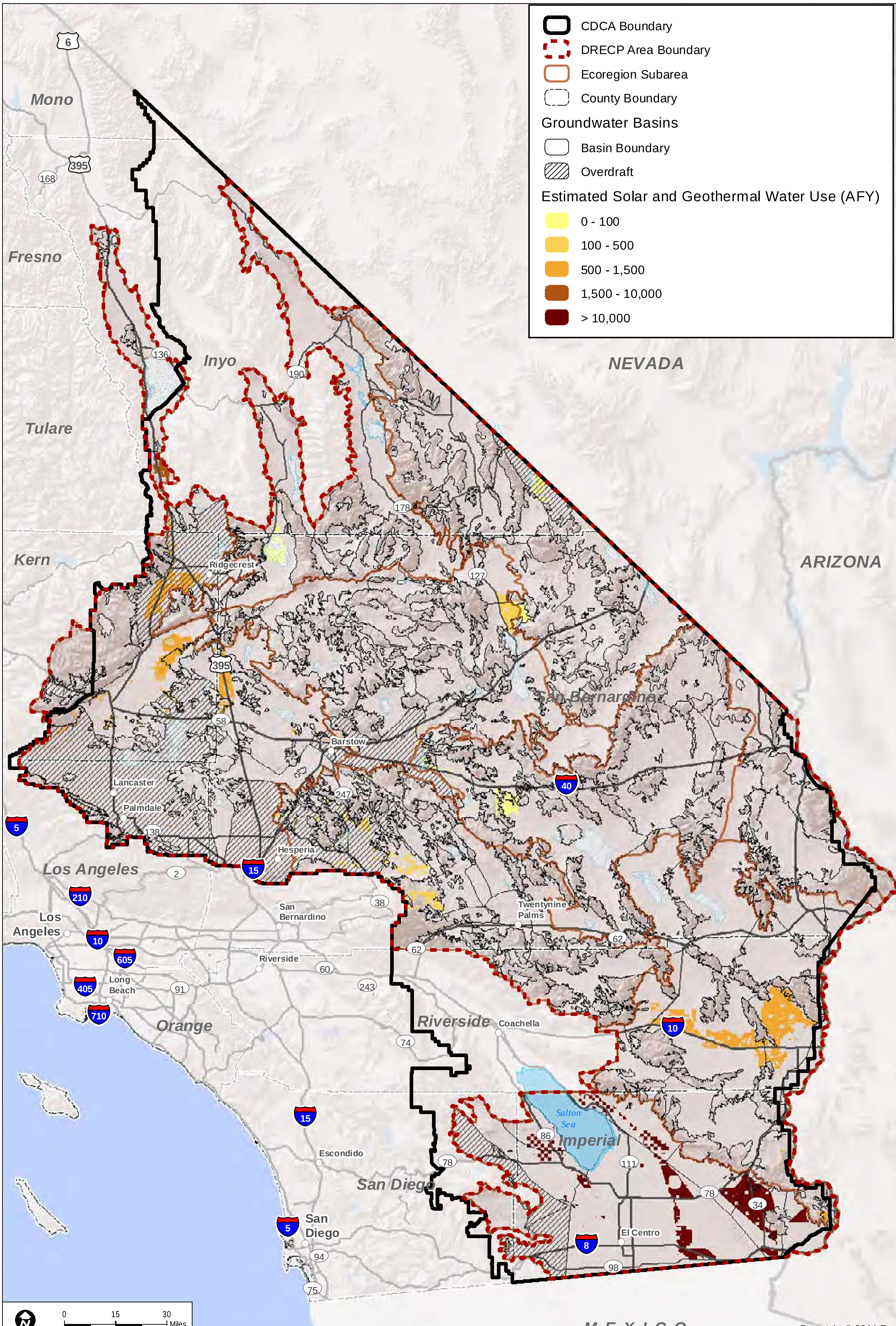
Table IV.6-4 shows the estimated total new water use by solar and geothermal projects within each ecoregion subarea. Total water use was calculated using the projected megawatt distribution and water use factors described in Section IV.6.1, Approach to Impact Analysis. The water use shown in Table IV.6-2 assumes that dry-cooled solar thermal technology will be used because of water scarcity in the desert basins. Estimated total use is 44,000 ac-ft/yr, and ranges from a minimum of 30 ac-ft/yr (Panamint Death Valley ecoregion subarea) to a maximum of 36,000 ac-ft/yr (Imperial Borrego Valley ecoregion subarea); there is no development and therefore no renewable energy water use in the Piute Valley and Sacramento Mountains ecoregion subarea. Wet-cooled geothermal projects account for almost 42,000 ac-ft/yr of the total water use under Alternative 2. Eighty-two percent of the water use under Alternative 2 is in the Imperial Borrego Valley ecoregion subareas because there are 6,000 acres of geothermal technology and 8,000 acres of solar technology.

Table IV.6-4
Renewable Energy Development Area and Estimated Water Use – Alternative 2

Ecoregion Subarea	Renewable Energy Development Focus Area (acres)			MW	Water Use (AFY)
	Solar	*Geothermal*	*Total*		
Cadiz Valley and Chocolate Mountains	11,000	0	16,000	3,000	600
Imperial Borrego Valley	8,000	6,000	19,000	4,000	36,000
Kingston and Funeral Mountains	1,000	0	1,000	200	50
Mojave and Silurian Valley	2,000	0	5,000	500	200
Owens River Valley	400	1,000	1,000	300	6,000
Panamint Death Valley	600	0	700	100	30
Pinto Lucerne Valley and Eastern Slopes	2,000	0	6,000	1,000	100
Piute Valley and Sacramento Mountains	0	0	0	0	0
Providence and Bullion Mountains	1,000	0	2,000	400	50
West Mojave and Eastern Slopes	12,000	0	29,000	2,000	600
Total	**39,000**	**7,000**	**79,000**	**11,000**	**44,000**

Total megawatts for all technologies combined using the energy generation described in Appendix O (Methods for Megawatt Distribution).
Estimated solar thermal water use included industrial processes (0.5 ac-ft/yr/MW) and cooling (minimum estimate of 1 ac-ft/yr/MW represented by dry-cooled technology); photovoltaic water use for cleaning (0.05 ac-ft/yr/MW), and geothermal water use for cooling (assumed wet-cooled technology at 31 ac-ft/yr/MW); water use for wind assumed negligible.
Total development area is the sum of solar, geothermal, wind, and transmission project areas. Note that transmission acres include transmission only within groundwater basins.
Note: The following general rounding rules were applied to calculated values: values greater than 1,000 were rounded to the nearest 1,000; values less than 1,000 and greater than 100 were rounded to the nearest 100; values of 100 or less were rounded to the nearest 10, and therefore totals may not sum due to rounding. In cases where subtotals are provided, the subtotals and the totals are individually rounded. The totals are not a sum of the rounded subtotals; therefore the subtotals may not sum to the total within the table.

Under Alternative 2, renewable energy development can occur in a number of overdraft basins and groundwater basins identified as stressed. Figure IV.6-5 maps the distribution of estimated water use by DFA and overdraft groundwater basins, and Figure IV.6-6 maps the water use by DFA and by overdraft and stressed groundwater basins.



Sources: ESRI (2014); California Department of Water Resources (2003)

FIGURE IV.6-5

Planned Development Areas, Estimated Solar and Geothermal Water Use, and Overdraft Groundwater Basins - Alternative 2

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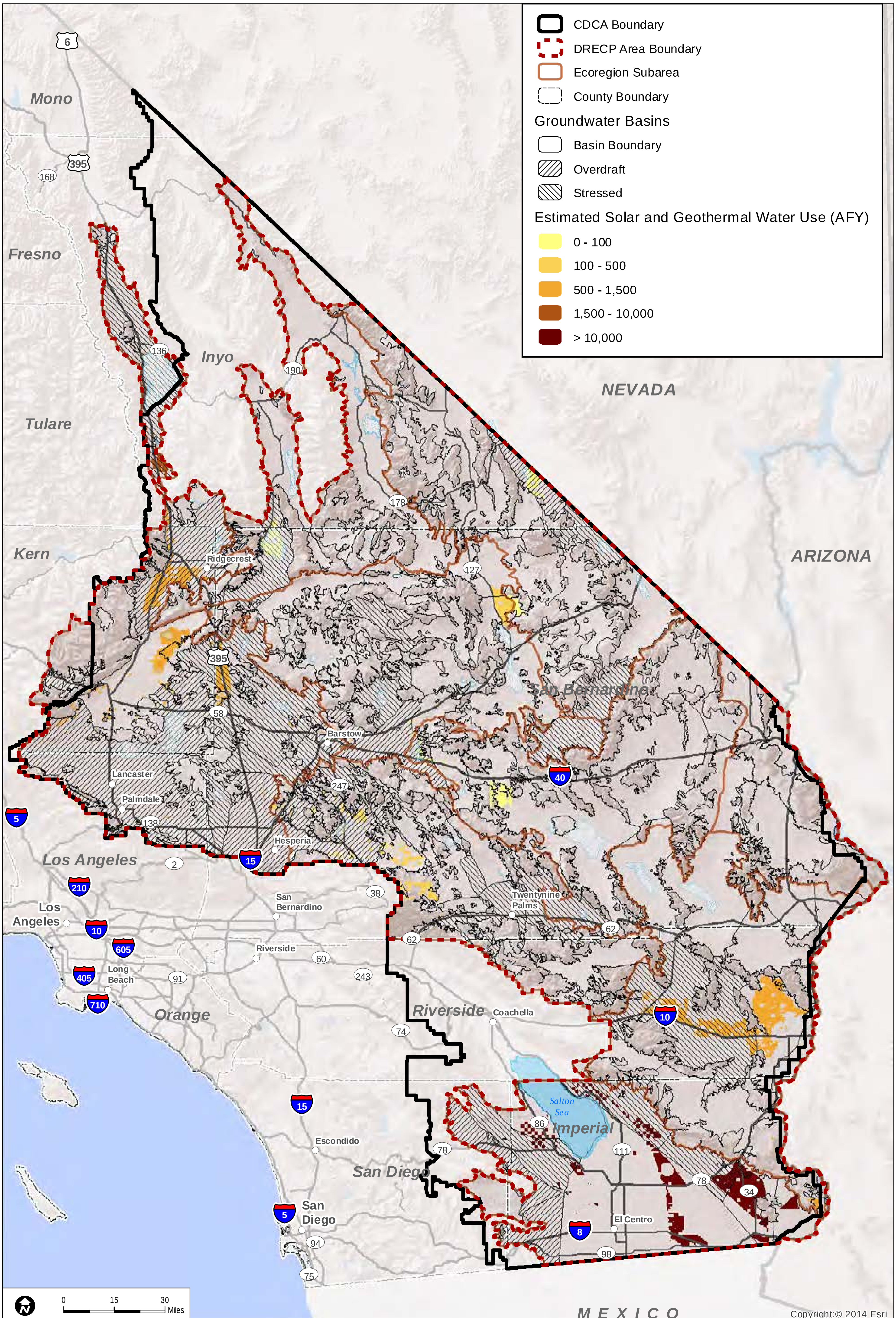

Sources: ESRI (2014); California Department of Water Resources (2003)

FIGURE IV.6-6

Planned Development Areas, Estimated Solar and Geothermal Water Use, and Overdraft and Stressed Groundwater Basins - Alternative 2

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Development occurs in 19 overdraft and stressed groundwater basins, and increased groundwater use in these sensitive basins can adversely affect water supplies and exacerbate impacts from overdraft conditions and declining groundwater levels.

Some of the developed basins under Alternative 2 can be hydraulically connected to areas located outside the DRECP area. Renewable energy projects occur in groundwater basins connected to areas within Mexico (the Imperial Valley Ogilby Valley basins, located in the Imperial Borrego Valley ecoregion subarea), Nevada (the Pahrump Valley Basin, located in the Kingston and Funeral Mountains ecoregion subarea), and Arizona (Yuma Valley Basin, located in the Imperial Borrego Valley and Cadiz Valley and Chocolate Mountain ecoregion subareas). Groundwater level and water supply changes can therefore extend across these boundaries and impact areas outside the DRECP area including the Colorado River.

Alternative 2 designates new NLCS lands, new ACECs and wildlife allocations, expands and reduces existing ACECs, designates new SRMAs, expands and reduces existing SRMAs, creates buffer corridors along National Scenic and Historic Trails, and manages lands with wilderness characteristics. The BLM LUPA also replaces MUCs, and establishes VRM Classes in the CDCA. More than 6.6 million acres are assumed allocated in the BLM LUPA land designation under Alternative 2. Because BLM LUPA land designations protect ecological, historic, cultural, scenic, scientific, and recreation resources and values, the use of or access to groundwater resources to meet renewable energy project water requirements would likely be limited. Groundwater-related CMAs are the same for all alternatives.

Under the Proposed BLM LUPA, the only changes outside the DRECP area would be the designation of NLCS lands, ACECs, and National Scenic and Historic Trails management corridors, VRM Classes, and new land allocations to replace MUCs on CDCA lands. The estimated acres of groundwater basins in BLM LUPA lands located outside the DRECP area under the Alternative 2 are summarized in Table R2.6-7 (Appendix R2). Because the BLM LUPA land designations outside the DRECP area protect ecological, historic, cultural, scenic, scientific, and recreation resources and values, the use of or access to groundwater resources to meet renewable energy project water requirements would likely be limited.

Impact GW-1: Construction of DRECP components could alter groundwater recharge.

Impacts on groundwater recharge from land disturbance under Alternative 2 would be similar to those shown in Section IV.6.3.1.1. Alternative 2 potentially affects recharge on 79,000 acres.

Impact GW-2: Groundwater consumption lowers groundwater levels, depletes water supplies, and affects groundwater quality and groundwater discharge.

Impacts on groundwater levels would be similar to those shown in Section IV.6.3.1.1. The greatest water use is in the Imperial Borrego Valley and Owens River Valley ecoregion subareas (42,000 ac-ft/yr), where most of the water use is for geothermal technology (7,000 acres) and solar technology (8,400 acres). The remaining water use is mostly for solar technology in the Cadiz Valley and Chocolate Mountains, Mojave and Silurian Valley, Pinto Lucerne Valley and Eastern Slopes, and West Mojave and Western Slopes ecoregion subareas. Nineteen basins within these ecoregion subareas are in overdraft or are characterized as stressed (Figure IV.6-6), and groundwater use for renewable energy projects will likely exacerbate depletion of the water supply and the magnitude and scope of adverse impacts.

Impact GW-3: Groundwater consumption could cause land subsidence and permanently decrease storage capacity.

Land subsidence would cause impacts similar to those shown in Section IV.6.3.1.1. As shown in Table IV.6-4, renewable energy water use under Alternative 2 is 44,000 ac-ft/yr, with most of the water use attributed to geothermal and solar technologies in the Imperial Borrego Valley.

Impact GW-4: Groundwater consumption could cause existing poor-quality groundwater to migrate.

Impacts from the potential migration of poor-quality groundwater would be similar to those shown in Section IV.6.3.1.1. The large amount of potential groundwater use could cause poor-quality groundwater to migrate.

Impact GW-5: Injection of water from geothermal steam generation could contaminate potable water supplies.

The potential for impacts from the injection of saline water for geothermal steam water is shown in Section IV.6.3.1.1. Geothermal development increases the potential for contamination, particularly in the Imperial Borrego Valley and Owens River Valley ecoregion subareas where geothermal development would occur.

Impact GW-6: Chemical spills or brine disposal could contaminate groundwater.

Groundwater contamination from chemical spills or brine disposal is shown in Section VI.6.3.1.1.

Impacts on Variance Process Lands

Variance Process Lands are neither reserve lands nor DFAs. They are a subset of the variance lands identified in the Solar PEIS ROD and additional lands that, based on current information, have moderate to low ecological value and ambiguous value for renewable energy. If renewable energy development occurs on Variance Process Lands, a LUPA would not be required, so the environmental review process would be somewhat simpler than if the location were left undesignated.

Variance Process Lands for each alternative are shown in Chapter IV.1, Table IV.1-2 and in Volume II, Chapter II.5, Figure II.5-1 for Alternative 2. Development of Variance Process Lands would have similar air quality effects as described in Impacts GW-1 through GW-6.

Impact Reduction Strategies

Design Features of the Solar PEIS

The Solar PEIS includes Design Features (Appendix W) that would reduce the impacts of solar energy development, including: measures to control runoff (defined in WR1-1), measures to quantify groundwater aquifers and sustainable yield (defined in WR1-2), measures to secure a reliable and legally available water supply (defined in WR1-3), and impact reduction measures (defined in WR2-1, WR3-1, and WR4-1 for construction, operation, and decommissioning, respectively). These measures would apply only on BLM SEZs and Solar PEIS variance lands.

Conservation and Management Actions

The conservation strategy for Alternative 2 (presented in Volume II, Section II.5.4) defines specific actions that would reduce the impacts of this alternative. The conservation strategy includes definition of the conservation designations and specific CMAs for the Preferred Alternative. The CMAs described in Section IV.6.3.2.1 apply to Alternative 2.

Laws and Regulations

Existing laws and regulations would further reduce the impacts of renewable energy development projects constructed subsequent to the Proposed LUPA. Relevant regulations are presented in the Regulatory Setting in Volume III, and summarized in Section IV.6.3.1.1.

IV.6.3.4.2 Impacts of Ecological and Cultural Conservation and Recreation Designations

The estimated acreage of groundwater basins in Ecological and Cultural Conservation and Recreation Designations is summarized in Table R2.6-8 (Appendix R2). These lands include existing protected areas (LLPAs and MEMLs) and Alternative 2 existing and proposed BLM conservation lands (NLCS lands, ACECs, and wildlife allocations). No renewable energy development is allowed on existing protected areas, and the use of or access to groundwater resources to meet renewable energy project water requirements would likely be limited. Accordingly, no adverse impacts are expected to groundwater resources because of the conservation and recreation designations. Under Alternative 2, renewable energy development is restricted on over 2.5 million acres within 37 overdraft or stressed groundwater basins, thereby protecting and preserving groundwater and water-supply conditions in these sensitive areas.

IV.6.3.4.3 Impacts of Transmission Outside the DRECP Area

The impacts of transmission outside the DRECP area on groundwater, water supply, and water quality would be the same under all alternatives. These impacts are as described in the No Action Alternative in Section IV.6.3.1.3, Impacts of Transmission Outside the DRECP Area in the No Action Alternative.

IV.6.3.4.4 Comparison of Alternative 2 With Preferred Alternative

Alternative 2 develops 9,000 acres more land for renewable energy projects than the Preferred Alternative (79,000 acres versus 70,000 acres, respectively). This increases the potential for chemical spills and groundwater contamination, but existing regulations and Best Management Practices (BMPs) reduce potential groundwater contamination impacts in both alternatives. Land disturbances resulting from renewable energy development have the potential to alter groundwater recharge, but with mitigation these changes may increase groundwater recharge. Alternative 2 therefore has greater potential to increase groundwater recharge over a greater area relative to the Preferred Alternative.

Renewable energy projects in Alternative 2 are estimated to use the same amount of water as the Preferred Alternative (44,000), with most of the use for both alternatives concentrated in solar and geothermal technologies in the Imperial Borrego Valley ecoregion subarea. The CMAs and associated mitigation apply to either alternative, and ensure that no project is approved unless it is shown that the water supply is adequate to support development without causing an adverse impact.

Geographic Distinctions

Solar and geothermal technologies account for most renewable energy-related water use, so the locations of these projects are important to consider. Alternative 2 develops solar and geothermal projects in 19 of the 39 overdraft or stressed basins identified in the DRECP area (Figure IV.6-6); the Preferred Alternative develops projects in 15 overdraft or stressed basins (Figure IV.6-2). Alternative 2 therefore develops projects in a greater number of sensitive groundwater basins. The CMAs and associated mitigation apply to either alternative, and ensure that no project is approved unless it is shown that the water supply is adequate to support development without causing an adverse impact.

Development occurs in the Pahrump Valley Basin under Alternative 2. Groundwater in deep limestone formations beneath the Pahrump Valley Basin and surrounding areas may support groundwater discharge to the Amargosa River and springs located along the east side of the Death Valley Basin. The Preferred Alternative and Alternative 2 also plan for development in the Imperial Valley and Palo Verde Mesa basins, creating the potential for groundwater level and water supply changes that extend across the DRECP area boundaries and impact areas in Mexico and Arizona and the Colorado River.

IV.6.3.5 Alternative 3

IV.6.3.5.1 Impacts of Renewable Energy and Transmission

Alternative 3 integrates renewable energy, BLM LUPA components, and conservation components of the DRECP Preferred Alternative in the DRECP area. It includes geographically dispersed DFAs on BLM lands, and emphasizes solar and geothermal technologies. The estimated renewable energy development pattern include:

- Dispersed solar with emphasis in two ecoregion subareas: Cadiz Valley and Chocolate Mountains and Imperial Borrego Valley.
- Emphasis on wind in three ecoregion subareas: Cadiz Valley and Chocolate Mountains, Imperial Borrego Valley, and Pinto Lucerne Valley and Eastern Slopes.
- Geothermal in two ecoregion subareas: Imperial Borrego Valley and Owens River Valley.

Impact Assessment

Potential renewable energy development area on BLM lands within DRECP area groundwater basins under Alternative 3 is shown in Table IV.6-5 (solar only, geothermal only, and total renewable energy development for all technologies, including wind and transmission). Development would occur in 25 groundwater basins. Most (87%) of the developed area is within four ecoregion subareas: Cadiz Valley and Chocolate Mountains, Imperial Borrego Valley, Pinto Lucerne Valley and Eastern Slopes, and West Mojave and Eastern Slopes. There are geothermal projects in the Imperial Borrego Valley (6,000 acres) and Owens River Valley (1,000 acres) ecoregion subareas. Two ecoregion subareas (Kingston and Funeral Mountains and Piute Valley and Sacramento Mountains) have no development under Alternative 3.

Table IV.6-5 shows the estimated total new water use by solar and geothermal projects within each ecoregion subarea. Total estimated water use was calculated using the projected megawatt distribution and water use factors described in Section IV.6.1, Approach to Impact Analysis. The water use shown in Table IV.6-5 assumes that dry-cooled solar thermal technology will be used because of water scarcity in the desert basins. Estimated total use is 44,000 ac-ft/yr, and ranges from a minimum of 60 ac-ft/yr (Providence and Bullion Mountains ecoregion subarea) to a maximum of 37,000 ac-ft/yr (Imperial Borrego Valley ecoregion subarea) in the ecoregion subareas were development would occur. Wet-cooled geothermal projects account for almost 42,000 ac-ft/yr of the total water use under Alternative 3. Ninety eight percent of the water use under Alternative 3 is in the Imperial Borrego Valley and Owens River Valley ecoregion subareas because there are 7,000 acres of geothermal projects and 12,000 acres of solar projects.

Under Alternative 3, renewable energy development can be sited in a number of overdraft basins or stressed groundwater basins. Figure IV.6-7 maps the distribution of estimated water use by DFA and overdraft groundwater basins, and Figure IV.6-8 maps the water use by DFA and overdraft and stressed groundwater basins. Development occurs in 17 overdraft and stressed groundwater basins, and increased groundwater use in these sensitive basins can adversely affect water supplies and exacerbate impacts associated with overdraft conditions and declining groundwater levels.

Table IV.6-5
Renewable Energy Development Area and Estimated Water Use – Alternative 3

Ecoregion Subarea	Renewable Energy Development Focus Area (acres)			MW	Water Use (AFY)
	Solar	*Geothermal*	*Total*		
Cadiz Valley and Chocolate Mountains	8,000	0	12,000	1,000	400
Imperial Borrego Valley	11,000	6,000	23,000	3,000	37,000
Kingston and Funeral Mountains	0	0	0	0	0
Mojave and Silurian Valley	600	0	3,000	100	100
Owens River Valley	1,000	1,000	2,000	300	6,000
Panamint Death Valley	1,000	0	2,000	200	100
Pinto Lucerne Valley and Eastern Slopes	3,000	0	6,000	500	100
Piute Valley and Sacramento Mountains	0	0	0	0	0

Table IV.6-5
Renewable Energy Development Area and Estimated Water Use – Alternative 3

Ecoregion Subarea	Renewable Energy Development Focus Area (acres)			MW	Water Use (AFY)
	Solar	*Geothermal*	*Total*		
Providence and Bullion Mountains	1,000	0	1,000	200	60
West Mojave and Eastern Slopes	4,000	0	5,000	600	200
Total	**29,000**	**7,000**	**53,000**	**6,000**	**44,000**

Total megawatts for all technologies combined using the energy generation described in Appendix O (Methods for Megawatt Distribution).
Estimated solar thermal water use included industrial processes (0.5 ac-ft/yr/MW) and cooling (minimum estimate of 1 ac-ft/yr/MW represented by dry-cooled technology); photovoltaic water use for cleaning (0.05 ac-ft/yr/MW), and geothermal water use for cooling (assumed wet-cooled technology at 31 ac-ft/yr/MW); water use for wind assumed negligible.
Total development area is the sum of solar, geothermal, wind, and transmission project areas. Note that transmission acres include transmission only within groundwater basins.
Note: The following general rounding rules were applied to calculated values: values greater than 1,000 were rounded to the nearest 1,000; values less than 1,000 and greater than 100 were rounded to the nearest 100; values of 100 or less were rounded to the nearest 10, and therefore totals may not sum due to rounding. In cases where subtotals are provided, the subtotals and the totals are individually rounded. The totals are not a sum of the rounded subtotals; therefore the subtotals may not sum to the total within the table

Under Alternative 3, planned renewable energy development would be in basins hydraulically connected to adjacent areas located outside the DRECP area. (See Figure IV.6-7 for the locations and distribution of development areas.) Renewable energy projects occur in groundwater basins connected to areas within Mexico (the Imperial Valley and Ogilby Valley basins, located in the Imperial Borrego Valley ecoregion subarea), and Arizona (Palo Verde Mesa basin, located in the Cadiz Valley and Chocolate Mountain ecoregion subarea). Groundwater level and water supply changes can therefore extend across these boundaries and impact areas outside the DRECP area including the Colorado River.

Alternative 3 designates new NLCS lands, new ACECs and wildlife allocations, expands and reduces existing ACECs, designates new SRMAs, and expands and reduces existing SRMAs, creates buffer corridors along National Scenic and Historic Trails, and manages lands with wilderness characteristics. The BLM LUPA also replaces MUCs and establishes VRM Classes in the CDCA. More than 6.7 million acres are assumed to be allocated in the BLM LUPA land designation under Alternative 3. Because the BLM LUPA land designations under Alternative 3 protect ecological, historic, cultural, scenic, scientific, and recreation resources and values, the use of or access to groundwater resources to meet renewable energy project water requirements would likely be limited. Groundwater-related CMAs are the same for all alternatives.

Under the Proposed BLM LUPA, the only changes outside the DRECP area would be the designation of NLCS lands, ACECs, and National Scenic and Historic Trails management corridors, VRM Classes, and new land allocations to replace MUCs on CDCA lands. The estimated acres of groundwater basins in BLM LUPA lands outside the DRECP area under Alternative 3 are summarized in Table R2.6-9 (Appendix R2). Because the BLM LUPA land designations outside the DRECP area protect ecological, historic, cultural, scenic, scientific, and recreation resources and values, the use of or access to groundwater resources to meet renewable energy project water requirements would likely be limited.

Impact GW-1: Construction of DRECP components could alter groundwater recharge.

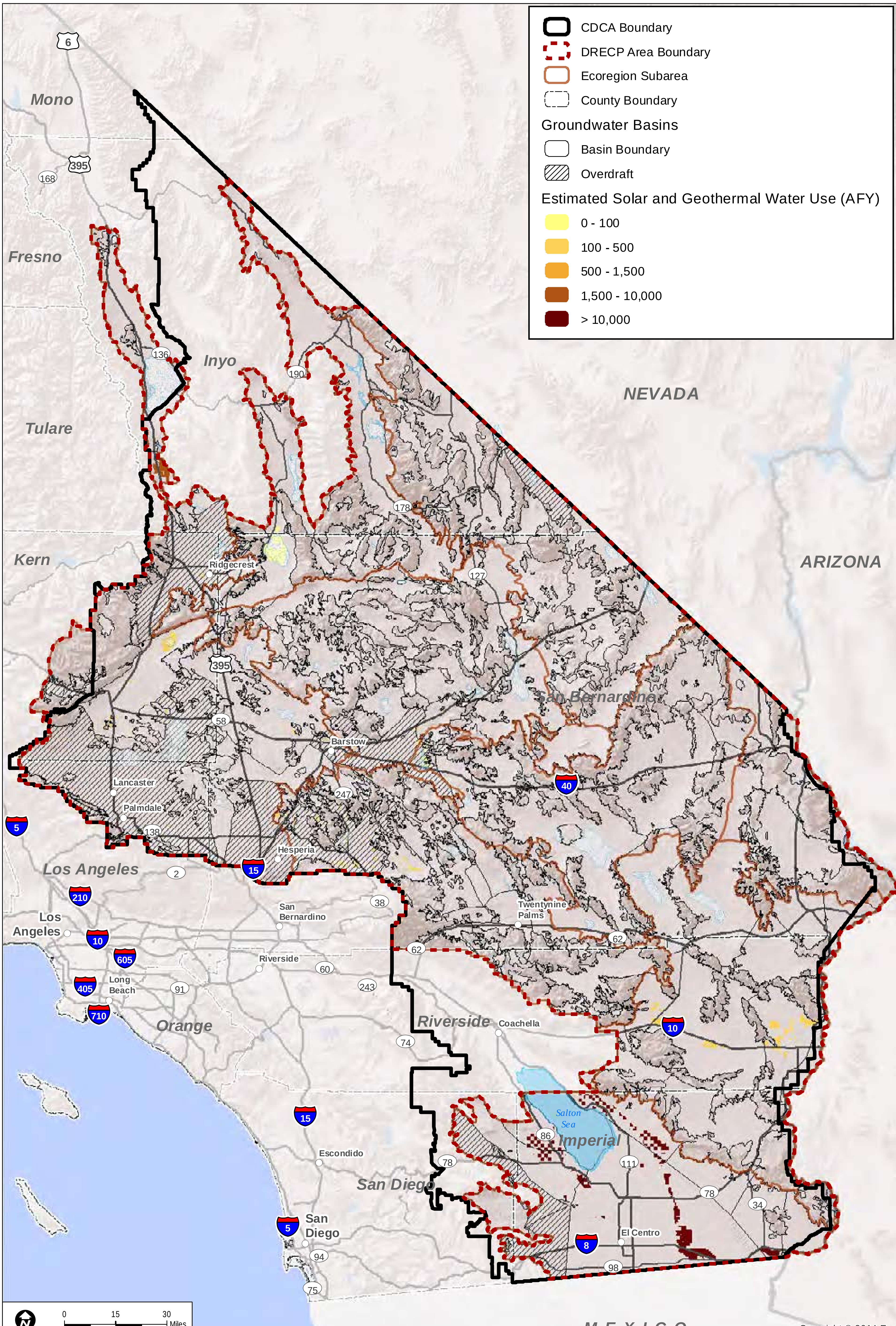
Impacts on groundwater recharge resulting from land disturbance under Alternative 3 would be similar to those shown in Section IV.6.3.1.1. Alternative 3 potentially affects recharge on 53,000 acres.

Impact GW-2: Groundwater consumption lowers groundwater levels, depletes water supplies, and affects groundwater quality and groundwater discharge.

Impacts on groundwater levels would be similar to those shown in Section IV.6.3.1.1. The greatest potential water use is in the Imperial Borrego Valley (37,000 ac-ft/yr) ecoregion subarea, mostly for geothermal technology (6,000 acres) and solar technology (11,000 acres). An additional 6,000 ac-ft/yr of water use is also planned in the Owens River Valley ecoregion subarea, and that water use is also primarily for geothermal and solar technologies (1,000 and 1,000 acres, respectively). The remaining water use in the DRECP area is for solar technology located in the Cadiz Valley and Chocolate Mountains, Mojave and Silurian Valley, Panamint Death Valley, Pinto Lucerne Valley and Eastern Slopes, Providence and Bullion Mountains, and West Mojave and Western Slopes ecoregion subareas. Seventeen basins within these ecoregion subareas are in overdraft or characterized as stressed (Figure IV.6-8), and groundwater use for renewable energy projects will likely exacerbate depletion of the water supply and increase the magnitude and scope of adverse impacts.

Impact GW-3: Groundwater consumption could cause land subsidence and permanently decrease storage capacity.

Land subsidence would cause impacts similar to those shown in Section IV.6.3.1.1. As shown in Table IV.6-5, renewable energy water use under Alternative 3 is 44,000 ac-ft/yr, with most of the water use attributed to geothermal and solar development in the Imperial Borrego Valley ecoregion subarea.



Sources: ESRI (2014); California Department of Water Resources (2003)

FIGURE IV.6-7

Planned Development Areas, Estimated Solar and Geothermal Water Use, and Overdraft Groundwater Basins - Alternative 3

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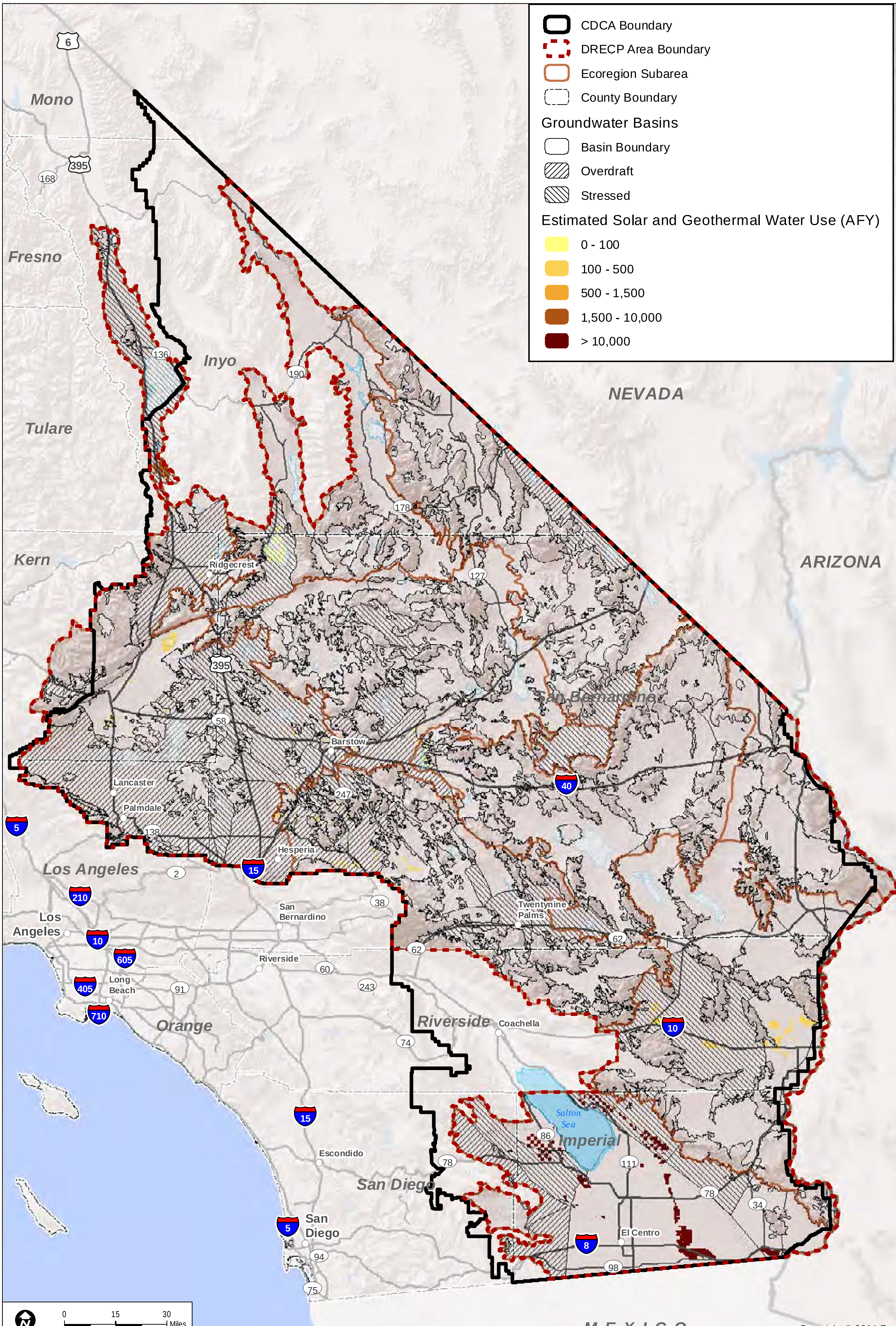

Sources: ESRI (2014); California Department of Water Resources (2003)

FIGURE IV.6-8

Planned Development Areas, Estimated Solar and Geothermal Water Use, and Overdraft and Stressed Groundwater Basins - Alternative 3

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Impact GW-4: Groundwater consumption could cause existing poor-quality groundwater to migrate.

Impacts from the potential migration of poor-quality groundwater would be similar to those shown in Section IV.6.3.1.1. The large amount of renewable energy development could affect groundwater quality.

Impact GW-5: Injection of water for geothermal steam generation could contaminate potable water supplies.

The potential for impacts from injection of saline water for geothermal steam water would be as shown in Section IV.6.3.1.1. Geothermal development increases the potential for contamination, with potential impacts in the Imperial Borrego Valley and Owens River Valley ecoregion subareas.

Impact GW-6: Chemical spills or brine disposal could contaminate groundwater.

Groundwater contamination from chemical spills or brine disposal would be as shown in Section VI.6.3.1.1.

Impacts on Variance Process Lands

Variance Process Lands are neither reserve lands nor DFAs. They are a subset of the variance lands identified in the Solar PEIS ROD and additional lands that, based on current information, have moderate to low ecological value and ambiguous value for renewable energy. If renewable energy development occurs on Variance Process Lands, a LUPA would not be required, so the environmental review process would be somewhat simpler than if the location were left undesignated.

Variance Process Lands for each alternative are as shown in Chapter IV.1, Table IV.1-2 and in Volume II, Chapter II.5, Figure II.5-1 for Alternative 3. Development of the Variance Process Lands would have similar air quality effects as described above under Impacts GW-1 through GW-6.

Impact Reduction Strategies

Design Features of the Solar PEIS

The Solar Programmatic EIS (PEIS) includes Design Features (Appendix W) that would reduce the impacts of solar energy development, including: measures to control runoff (defined in WR1-1); measures to quantify groundwater aquifers and sustainable yield (defined in WR1-2); measures to secure a reliable and legally available water supply (defined in WR1-3); and impact reduction measures (defined in WR2-1, WR3-1, and WR4-1 for construction, operation, and decommissioning, respectively). These measures would apply only on BLM Solar Energy Zones and Solar PEIS variance lands.

Conservation and Management Actions

The conservation strategy for Alternative 3 (presented in Volume II, Section II.6.4) defines specific actions to reduce the impacts of this alternative. The conservation strategy includes definition of the Conservation Designations and specific CMAs for the Preferred Alternative. The CMAs described in Section IV.6.3.2 apply to Alternative 3.

Laws and Regulations

Existing laws and regulations would further reduce the impacts of renewable energy development projects constructed subsequent to the Proposed LUPA. Relevant regulations are presented in the Regulatory Setting in Volume III, and summarized in Section IV.6.3.1.1.

IV.6.3.5.2 Impacts of Ecological and Cultural Conservation and Recreation Designations

The estimated acreage of groundwater basins in Ecological and Cultural Conservation and Recreation Designations for Alternative 3 is summarized in Table R2.6-10 (Appendix R2). These lands include existing protected areas (LLPAs and MEMLs) and Alternative 3 existing and Proposed BLM conservation lands (NLCS lands, ACECs, and wildlife allocations). No renewable energy development is allowed in existing protected areas, and the use of or access to groundwater resources to meet renewable energy project water requirements would likely be limited. Accordingly, no adverse impacts are expected to groundwater resources from the conservation and recreation designations. Under Alternative 3, renewable energy development is restricted from over 2.3 million acres located within 37 overdraft or stressed groundwater basins, thereby protecting and preserving groundwater and water-supply conditions in these areas.

IV.6.3.5.3 Impacts of Transmission Outside the DRECP Area

The impacts of transmission outside the DRECP area on groundwater, water supply, and water quality would be the same under all alternatives. These impacts are as described for the No Action Alternative in Section IV.6.3.1.3, Impacts of Transmission Outside the DRECP Area in the No Action Alternative.

IV.6.3.5.4 Comparison of Alternative 3 With Preferred Alternative

Alternative 3 develops 17,000 acres less land for renewable energy projects than the Preferred Alternative (53,000 acres versus 70,000 acres, respectively). This decreases the potential for chemical spills and groundwater contamination, but existing regulations and BMPs reduce potential groundwater contamination impacts in both alternatives. Renewable energy development has the potential to alter groundwater recharge; with mitigation, these changes may increase groundwater recharge (e.g., installing pervious groundcover and directing runoff flows from a greater area to percolation basins). Because the developed area is smaller, Alternative 3 therefore has less potential to increase groundwater recharge relative to the Preferred Alternative.

Renewable energy projects in Alternative 3 are estimated to use the same amount of water as the Preferred Alternative (44,000 ac-ft/yr), with most of the use for both alternatives for geothermal projects in the Imperial Borrego Valley and Owens River Valley ecoregion subareas. The CMAs and associated mitigation apply to either alternative, and ensure that no project is approved unless it is shown that the water supply is adequate to support development without causing an adverse impact.

Geographic Distinctions

Solar and geothermal technologies account for most renewable energy-related water use, so the locations of these projects are important to consider. Alternative 3 develops solar and geothermal projects in 17 of the 39 overdraft or stressed groundwater basins in the DRECP area (Figure IV.6-8), where the Preferred Alternative develops projects in 15 of the basins (Figure IV.6-2). Alternative 3 therefore develops projects within a greater number of stressed groundwater basins than the Preferred Alternative. The CMAs and associated mitigation apply to either alternative and ensure that no project is approved unless it is shown that the water supply is adequate to support development without causing an adverse impact.

Relative to the Preferred Alternative, the development area under Alternative 3 does not include areas adjacent to Nevada, reducing the potential for groundwater level and water supply changes that could extend across the boundary and impact areas outside the DRECP area.

IV.6.3.6 Alternative 4

IV.6.3.6.1 Impacts of Renewable Energy and Transmission

Alternative 4 integrates the renewable energy BLM LUPA components, and other conservation components of the DRECP Preferred Alternative. It includes geographically dispersed DFAs on BLM lands with an expected mix of solar, wind, and geothermal technologies. The estimated renewable energy development patterns include:

- Emphasis on solar in the Cadiz Valley and Chocolate Mountains ecoregion subarea.

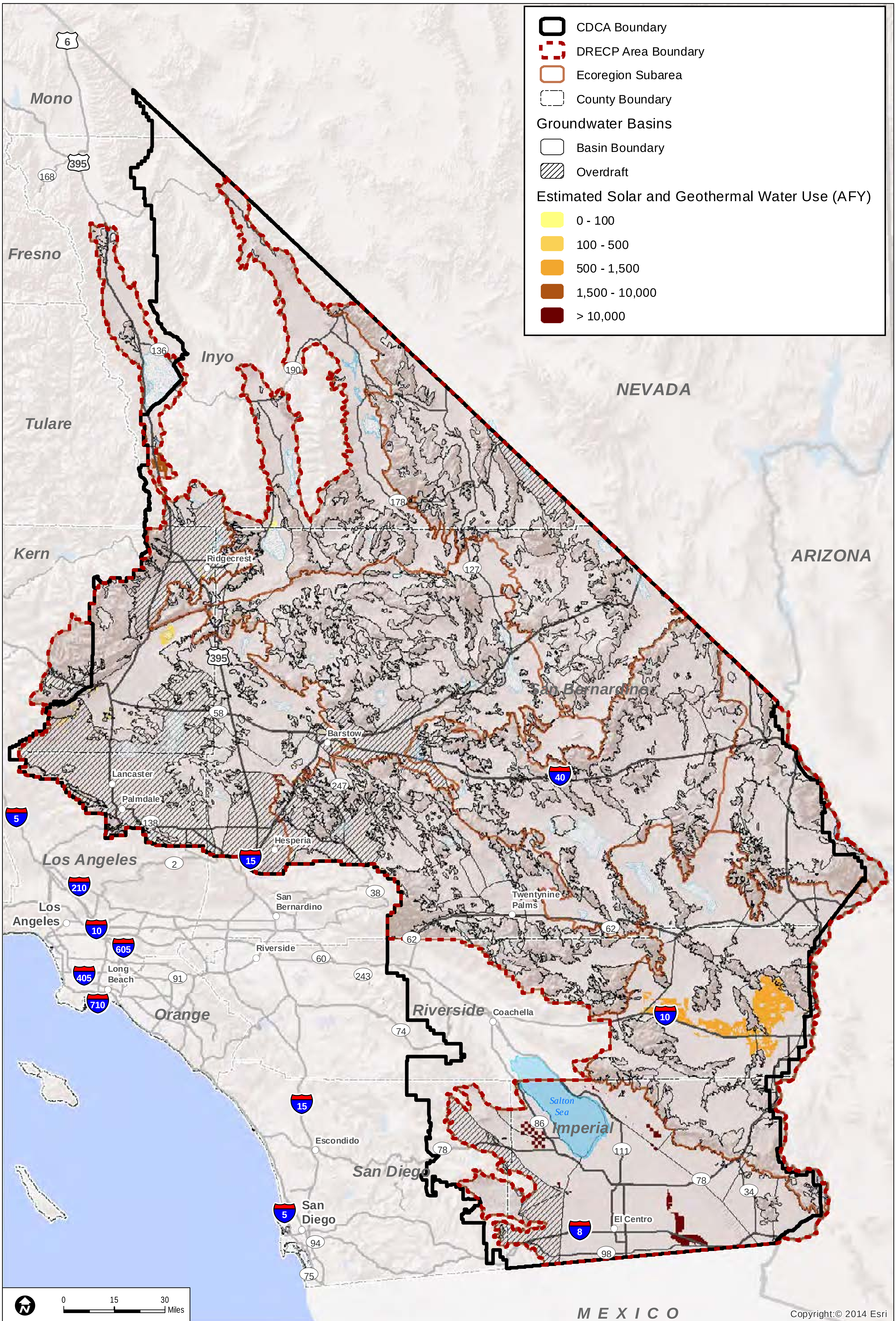
- Most wind development in the Cadiz Valley and Chocolate Mountains ecoregion subarea.
- Geothermal in the Imperial Borrego Valley and Owens River Valley ecoregion subareas.

Impact Assessment

Potential renewable energy development area on BLM lands within DRECP area groundwater basins under Alternative 4 is shown in Table IV.6-6 (solar only, geothermal only, and total renewable energy development for all technologies, including wind and transmission). Development would be in 23 groundwater basins. Most (85%) of the developed area is within three ecoregion subareas: Cadiz Valley and Chocolate Mountains, Imperial and Borrego Valley, and West Mojave and Eastern Slopes. There are geothermal projects in the Imperial Borrego Valley (4,000 acres) and Owens River Valley (1,000 acres) ecoregion subareas. Two ecoregion subareas (Kingston and Funeral Mountains and Piute Valley and Sacramento Mountains) have no planned development under Alternative 4.

Table IV.6-6 shows estimated total new water use by solar and geothermal projects within each ecoregion subarea. Total estimated water use was calculated using the projected megawatt distribution and water use factors as described above in Section IV.6.1, Approach to Impact Analysis. The water use shown in Table IV.6-2 assumes that dry-cooled solar thermal technology will be used because of water scarcity in the desert basins. Estimated total use is 35,000 ac-ft/yr, and ranges in available development areas from a minimum of 10 ac-ft/yr (Pinto Lucerne Valley and Eastern Slopes and Providence and Bullion Mountains ecoregion subareas) to a maximum of 27,000 ac-ft/yr (Imperial Borrego Valley ecoregion subarea) in the ecoregion subareas were development would occur . Wet-cooled geothermal projects account for about 33,000 ac-ft/yr of the total water use under Alternative 4. Ninety-seven percent of the total water use under Alternative 4 occurs in the Imperial Borrego Valley and Owens River Valley ecoregion subareas since they contains 5,000 acres of geothermal projects and almost 3,000 acres of solar projects.

Under Alternative 4, renewable energy projects can occur in a number of overdraft basins and groundwater basins identified as stressed. Figure IV.6-9 maps the distribution of estimated water use by DFA and overdraft groundwater basins, and Figure IV.6-10 maps water use by DFA, overdraft, and stressed groundwater basins. Development is planned in 17 overdraft and stressed groundwater basins, and the increased groundwater use in these sensitive basins can adversely affect water supplies and exacerbate impacts associated with overdraft conditions and declining groundwater levels. Existing regulations, implementation of CMAs, and additional measures required for renewable energy projects would mitigate impacts from development.



Sources: ESRI (2014); California Department of Water Resources (2003)

FIGURE IV.6-9

Planned Development Areas, Estimated Solar and Geothermal Water Use, and Overdraft Groundwater Basins - Alternative 4

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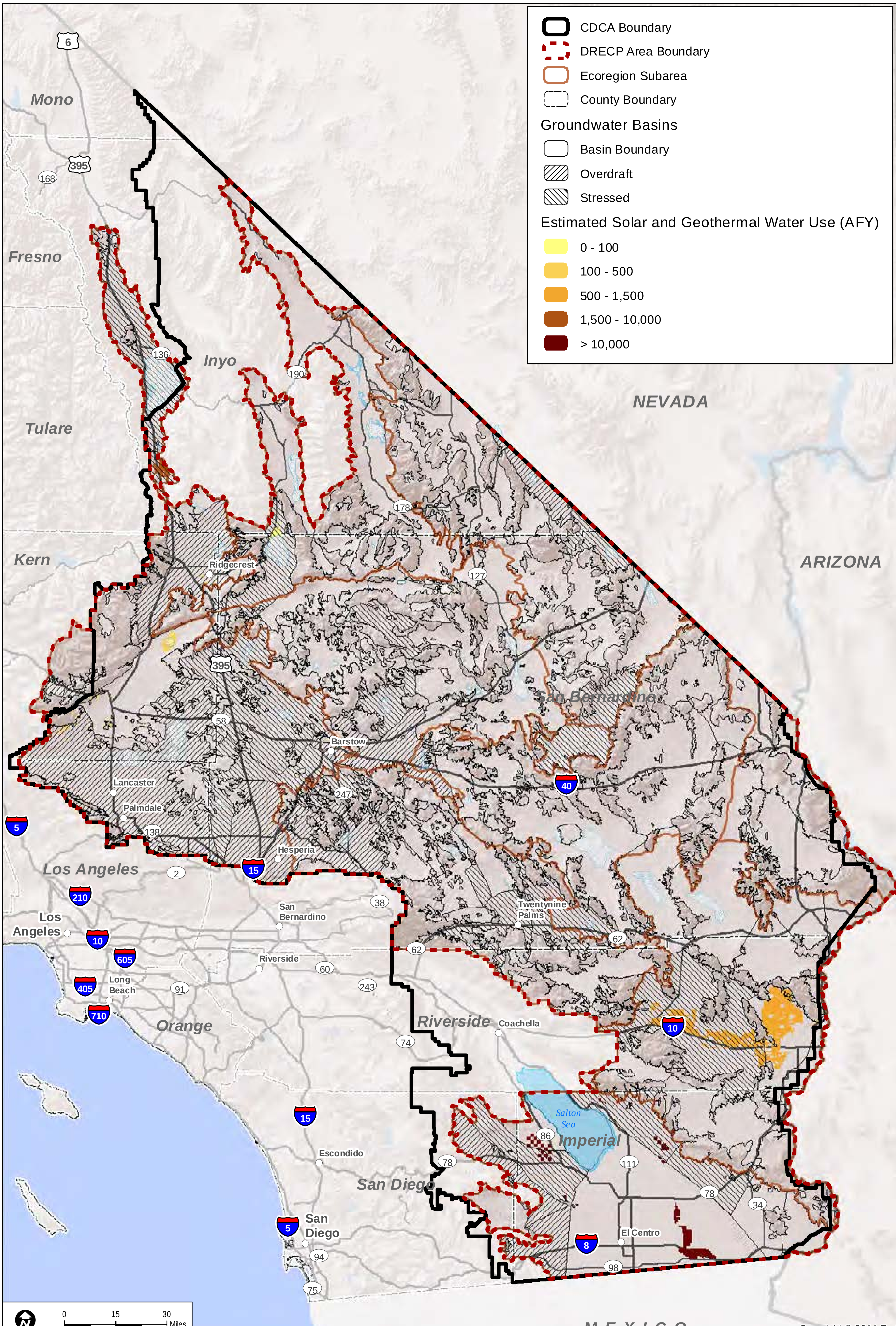

Sources: ESRI (2014); California Department of Water Resources (2003)

FIGURE IV.6-10

Planned Development Areas, Estimated Solar and Geothermal Water Use, and Overdraft and Stressed Groundwater Basins - Alternative 4

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Under Alternative 4, planned renewable energy development would be in basins hydraulically connected to adjacent areas located outside the DRECP area.(See Figure IV.6-9 for the locations and distribution of development areas.) Renewable energy projects are planned in groundwater basins connected to areas within Nevada (the Pahrump Valley basin, located in the Kingston and Funeral Mountains ecoregion subarea), Mexico (the Imperial Valley basin, located in the Imperial Borrego Valley ecoregion subarea), and Arizona (Palo Verde Mesa basin, located in the Cadiz Valley and Chocolate Mountain ecoregion subarea). Groundwater level and water supply changes can therefore extend across these boundaries and impact areas outside the DRECP area including the Colorado River.

Alternative 4 designates new NLCS lands, new ACECs and wildlife allocations, expands and reduces existing ACECs, designates new SRMAs, and expands and reduces existing SRMAs, and buffer corridors along National Scenic and Historic Trails. The BLM LUPA also replaces MUCs, and establishes VRM Classes in the CDCA. More than 4.5 million acres are assumed allocated in the BLM LUPA land designation under Alternative 4. Because the BLM LUPA land designations protect ecological, historic, cultural, scenic, scientific, and recreation resources and values, the use of or access to groundwater resources to meet renewable energy project water requirements would likely be limited.

Table IV.6-6
Renewable Energy Development Area and Estimated Water Use – Alternative 4

Ecoregion Subarea	Renewable Energy Development Focus Area (acres)			MW	Water Use (AFY)
	Solar	*Geothermal*	*Total*		
Cadiz Valley and Chocolate Mountains	27,000	0	33,000	5,000	1,000
Imperial Borrego Valley	2,000	4,000	11,000	1,000	27,000
Kingston and Funeral Mountains	0	0	0	10	<10
Mojave and Silurian Valley	0	0	3,000	20	100
Owens River Valley	800	1,000	2,000	300	7,000
Panamint Death Valley	700	0	700	100	30
Pinto Lucerne Valley and Eastern Slopes	200	0	4,000	100	10
Piute Valley and Sacramento Mountains	0	0	0	0	0
Providence and Bullion Mountains	200	0	200	20	10
West Mojave and Eastern Slopes	3,000	0	11,000	500	200
Total	**33,000**	**5,000**	**65,000**	**7,000**	**35,000**

Total megawatts for all technologies combined using the energy generation described in Appendix O (Methods for Megawatt Distribution).
Estimated solar thermal water use included industrial processes (0.5 ac-ft/yr/MW) and cooling (minimum estimate of 1 ac-ft/yr/MW represented by dry-cooled technology); photovoltaic water use for cleaning (0.05 ac-ft/yr/MW), and geothermal water use for cooling (assumed wet-cooled technology at 31 ac-ft/yr/MW); water use for wind assumed negligible.
Total development area is the sum of solar, geothermal, wind, and transmission project areas. Note that transmission acres include transmission only within groundwater basins.

Note: The following general rounding rules were applied to calculated values: values greater than 1,000 were rounded to the nearest 1,000; values less than 1,000 and greater than 100 were rounded to the nearest 100; values of 100 or less were rounded to the nearest 10, and therefore totals may not sum due to rounding. In cases where subtotals are provided, the subtotals and the totals are individually rounded. The totals are not a sum of the rounded subtotals; therefore the subtotals may not sum to the total within the table.

Under the Proposed BLM LUPA, the only changes outside the DRECP area would be the designation of NLCS lands, ACECs, National Scenic and Historic Trails management corridors, VRM Classes, and new land allocations to replace MUCs on CDCA lands. The estimated acreage of groundwater basins in BLM LUPA lands located outside the DRECP area under Alternative 4 is summarized in Table R2.6-11 (Appendix R2). Because the BLM LUPA land designations outside the DRECP area protect ecological, historic, cultural, scenic, scientific, and recreation resources and values, the use of or access to groundwater resources to meet renewable energy project water requirements would likely be limited.

Impact GW-1: Construction of DRECP components could alter groundwater recharge.

Impacts on groundwater recharge from land disturbance under Alternative 4 would be similar to those shown in Section IV.6.3.1.1. Alternative 4 potentially affects recharge on 65,000 acres.

Impact GW-2: Groundwater consumption lowers groundwater levels, depletes water supplies, and affects groundwater quality and groundwater discharge.

Impacts on groundwater levels would be similar to those shown in Section IV.6.3.1.1. The greatest potential water use is in the Imperial Borrego Valley and Owens River Valley ecoregion subareas (34,000 ac-ft/yr) ecoregion subarea, with most of the water use for geothermal technology (5,000 acres) and solar technology (2,800 acres). The remaining water use is mostly for solar technology located in the Cadiz Valley and Chocolate Mountains. Seventeen basins within these ecoregion subareas are in overdraft or are characterized as stressed (Figure IV.6-10). Groundwater use for renewable energy projects will likely exacerbate depletion of the water supply and the magnitude and scope of adverse impacts.

Impact GW-3: Groundwater consumption could cause land subsidence and permanently decrease storage capacity.

Land subsidence would cause impacts similar to those shown in Section IV.6.3.1.1. As shown in Table IV.6-6, renewable energy water use under Alternative 4 is 35,000 ac-ft/yr, with most of the water use attributed to geothermal and solar development in the Imperial Borrego Valley ecoregion subarea.

Impact GW-4: Groundwater consumption could cause existing poor-quality groundwater to migrate.

Impacts from the potential migration of poor-quality groundwater would be similar to those shown in Section IV.6.3.1.1. The large amount of renewable energy development could affect groundwater quality.

Impact GW-5: Injection of water for geothermal steam generation could contaminate potable water supplies.

The potential for impacts from injection of saline water for geothermal steam water is shown in Section IV.6.3.1.1. Geothermal development increases the potential for contamination, particularly in the Imperial Borrego Valley and Owens River Valley ecoregion subareas where geothermal development would be located.

Impact GW-6: Chemical spills or brine disposal could contaminate groundwater.

Groundwater contamination from chemical spills or brine disposal would be as shown in Section VI.6.3.1.1.

Impacts on Variance Process Lands

Variance Process Lands are neither reserve lands nor DFAs. They are a subset of the variance lands identified in the Solar PEIS ROD and additional lands that, based on current information, have moderate to low ecological value and ambiguous value for renewable energy. If renewable energy development occurs on Variance Process Lands, a LUPA would not be required, so the environmental review process would be somewhat simpler than if the location were left undesignated.

Variance Process Lands for each alternative are as shown in Chapter IV.1, Table IV.1-2 and in Volume II, Chapter II.6, Figure II.6-1 for Alternative 4. Development of the Variance Process Lands would have similar air quality effects as described above under Impacts GW-1 through GW-6.

Impact Reduction Strategies

Design Features of the Solar PEIS

The Solar PEIS includes Design Features (Appendix W) that would reduce the impacts of solar energy development, including: measures to control runoff (defined in WR1-1), measures to quantify groundwater aquifers and sustainable yield (defined in WR1-2), measures to secure a reliable and legally available water supply (defined in WR1-3), and impact reduction measures (defined in WR2-1, WR3-1, and WR4-1 for construction, operation, and decommissioning, respectively). These measures would apply only on BLM SEZs and Solar PEIS variance lands.

Conservation and Management Actions

The conservation strategy for Alternative 4 (presented in Volume II, Section II.7.4) defines specific actions that would reduce the impacts of this alternative. The conservation strategy includes definition of the conservations designations and specific CMAs for the Preferred Alternative. The CMAs summarized in Section IV.6.3.2 apply to Alternative 4.

Laws and Regulations

Existing laws and regulations would further reduce the impacts of renewable energy development projects constructed subsequent to the Proposed LUPA. Relevant regulations are presented in the Regulatory Setting in Volume III, and summarized in Section IV.6.3.1.1.

IV.6.3.6.2 Impacts of Ecological and Cultural Conservation and Recreation Designations

The estimated acres of groundwater basins in Ecological and Cultural Conservation and Recreation Designations are summarized in Table R2.6-12 (Appendix R2). These lands include the existing protected areas (LLPAs and MEMLs) and Alternative 4 existing and proposed BLM conservation lands (NLCS lands, ACECs, and wildlife allocations. No renewable energy development is allowed on existing protected areas, and the use of or access to groundwater resources to meet renewable energy project water requirements would be limited. No adverse impacts are therefore expected to groundwater resources because of the conservation and recreation designations. Under Alternative 4, renewable energy development is restricted on over 2.4 million acres located within 37 overdraft or stressed groundwater basins, thereby protecting and preserving groundwater and water supply conditions in these areas.

IV.6.3.6.3 Impacts of Transmission Outside the DRECP Area

The impacts of transmission outside the DRECP area on groundwater, water supply, and water quality would be the same under all alternatives. These impacts are described in the No Action Alternative in Section IV.6.3.1.3, Impacts of Transmission Outside the DRECP Area in the No Action Alternative.

IV.6.3.6.4 Comparison of Alternative 4 With Preferred Alternative

Alternative 4 develops 5,000 acres less area for renewable energy projects than the Preferred Alternative (65,000 acres versus 70,000 acres, respectively). This lowers the potential for chemical spills and groundwater contamination; but existing regulations and BMPs reduce potential groundwater contamination impacts in both alternatives. Renewable energy development has the potential to alter groundwater recharge; with mitigation these changes may increase groundwater recharge (e.g., installing pervious groundcover and directing runoff flows from a greater area to percolation basins). Because the developed area is smaller, Alternative 4 therefore has less potential to increase groundwater recharge relative to the Preferred Alternative.

Renewable energy projects in Alternative 4 are estimated to use less water than in the Preferred Alternative (35,000 ac-ft/yr versus 44,000 ac-ft/yr, respectively), with most of the water use for both alternatives from geothermal and solar technologies concentrated in the Imperial Borrego Valley. Existing regulations, implementation of CMAs, and additional measures required for renewable energy projects would reduce impacts under both alternatives. However, impacts from geothermal water use would remain for both the Preferred Alternative and Alternative 4.

Geographic Distinctions

Solar and geothermal technologies account for most renewable energy-related water use, so the locations of the projects and their associated groundwater use are important to consider. Alternative 4 develops solar and geothermal projects in 17 of the 39 overdraft or stressed groundwater basins in the DRECP area (Figure IV.6-10), where the Preferred Alternative develops projects in 15 of the basins (Figure IV.6-2). Alternative 4 therefore develops projects within more sensitive groundwater basins than the Preferred Alternative. Existing regulations, implementation of CMAs, and additional measures required for renewable energy projects would reduce impacts from development under both alternatives.

Under Alternative 4, no development is proposed in the Kingston and Funeral Mountains and Mojave and Silurian Valley ecoregion subareas. These ecoregion subareas have a small amount of proposed development under the Preferred Alternative. Under Alternative 1 there is no developed area adjacent to Nevada and the developed area is smaller adjacent to Mexico and Arizona (the Imperial Valley and Palo Verde Valley basins, respectively), reducing the potential for groundwater level and water supply changes that extend across their boundaries and impact areas outside the DRECP area and the Colorado River.

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